

CA20N
ER 35
S7N28



NEEDING

1957

FORESTRY
LAND USE

CONSERVATION REPORT

DEPARTMENT OF PLANNING AND DEVELOPMENT



Digitized by the Internet Archive
in 2024 with funding from
University of Toronto



Spruce planted under poplar restores neglected woodlands to profitable production.

Gov. Doc
Ont
P

Ontario, Planning and Development,
" Department of

DEPARTMENT OF PLANNING AND DEVELOPMENT

HON. W. M. NICKLE, Q.C.
Minister

T. A. C. TYRRELL
Deputy Minister

A. H. RICHARDSON
Chief Conservation Engineer

CA20N
ER35
57N28.

NEEBING VALLEY CONSERVATION REPORT 1957



TORONTO

1957



661473

2. 7. 57



One hundred copies of this report have
been prepared, of which this is
Number 41

Honourable W. M. Nickle, Minister,
Department of Planning and Development,
Parliament Buildings,
Toronto, Ontario.

Honourable Sir:

I take pleasure in transmitting
herewith the Conservation Report for the Neebing
River in the District of Thunder Bay.

The report covers Land, Forestry and
Water.

Yours very truly,

A. H. Richardson,
Chief Conservation Engineer

Toronto, May 26, 1957

C O N S E R V A T I O N B R A N C H

TECHNICAL STAFF

Chief Conservation Engineer and Director of the Branch:

A. H. RICHARDSON, M.A., C.M.Silv., F.E., P.Eng.

Assistant Director:

A.S.L. BARNES, B.Sc.F.

Soils and Land Use:

H. A. SMITH, B.A.

Forestry:

F. G. JACKSON, B.Sc.F.

Hydraulic Engineering:

C. E. BUSH, B.A.Sc., O.L.S., P.Eng.

J. W. MURRAY, B.A.Sc., P.Eng.

Hydrometeorologist:

J. P. BRUCE, M.A., A.R.Met.S.

Wildlife and Recreation:

K. M. MAYALL, M.A., B.Sc.F.

Historical Research:

V. B. BLAKE

Supervisor of Field Officers:

H. F. CROWN, B.S.A.

Authority Field Officers and Liaison:

W. D. ADLAM, B.Sc.F.
R. V. BRITTAIN, B.Sc.F.
M. CHUBB, B.Sc.F.
G. M. COUTTS, B.S.A.
K. G. HIGGS, B.Sc.F.
H. G. HOOKE, B.Sc.F.
L. N. JOHNSON, B.S.A.
A. D. LATORNELL, B.S.A., M.S.
R. M. LEWIS, B.S.A., M.S.
E. F. SUTTER, B.A.

Consultant in Hydraulic Engineering:

PROFESSOR G. ROSS LORD, B.A.Sc., S.M., Ph.D., P.Eng.

AUTHORSHIP

Field work for the Land Use and Forestry Section was done under the direction of H. A. Smith and F. G. Jackson, and this section was written by A. L. Burbidge.

The report for the Water Section was prepared by J. W. Murray from information supplied by the Authority and from the field work done and report submitted by R. K. Kilborn and Associates.

Editing and format were under the personal supervision of A. H. Richardson assisted by A.S.L. Barnes.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made of the co-operation received from the District Forester, the Ontario Agricultural College, the Agricultural Representatives and municipal officials, which has assisted materially in the preparation of this report. Thanks are also extended to Mr. Ayers, formerly engineer of the City of Fort William, and to Mr. Caverly of the Ontario Water Resources Commission, for information used in the Water section.

TABLE OF CONTENTS

Letter of Transmittal
Conservation Branch Staff
Authorship
Acknowledgements
Table of Contents
List of Illustrations, Graphs and Maps
Introduction
Recommendations

PART I - LAND USE AND FORESTRY

Chapter 1	General Geography	Page	1
	1. Location and Area	"	1
	2. Bedrock Geology	"	3
	3. Glaciation	"	4
	4. Hydrography and Water Resources	"	6
	5. Climate	"	8
	6. Soils	"	10
Chapter 2	Land Use	Page	18
	1. Introduction	"	18
	2. Land Tenure	"	19
	3. Land Use	"	22
Chapter 3	Capability of the Land	Page	26
	1. Introduction	"	26
	2. The Land Classification	"	27
	3. The Land Classes on the Watershed	"	29
	4. Forest Land Capability	"	32
Chapter 4	A Recommended Conservation Program	Page	34
	1. The Authority and Conservation Education	"	34
	2. Forest Conservation	"	35
	3. Authority Aid to Private Forestry	"	36
	4. Neebing Authority Forest	"	38
	5. Agricultural Development	"	41
	6. Farm Ponds	"	46
	7. Recreation	"	57

TABLES

Table I:	Municipal Acreage Drained by the Neebing	Page	1
Table II:	Watershed Areas	"	2
Table III:	Municipal Areas	"	3
Table IV:	Mean Temperature and Precipitation	Follows Page	8
Table V:	(Part 1) Land Types on the Neebing Watershed	}	Follows Page 15
	(Part 2) Land Types on the Neebing Watershed		

Table VI:	Present Land Use	Page 22
Table VII:	Neebing Valley Land Classes	" 33
Table VIII:	Recommended Authority Land Classification	" 39
	Authority Forest Agreement	Follows Page 40

PART II - WATER (FLOODS)

Chapter 1	Characteristics of the Watershed	Page 1
	1. Drainage Area	" 1
	2. River and Main Tributaries	" 1
Chapter 2	Hydrology	Page 3
	1. Recorded Stream Flows	" 3
	2. Future Flows	" 3
Chapter 3	The Flood and Low Flow Problem	Page 6
	1. Kind and Extent of Damages	" 6
	2. Flood and Low Flow Conditions	" 7
Chapter 4	Remedial Measures	Page 9
	1. Degree of Flood Protection	" 9
	2. Neebing Dam and Reservoir and Diversion Scheme	" 10

TABLES

	Maximum and Minimum Mean Daily and Mean Monthly Flows for the Neebing River	Follows Page 3
	Flood References	" 8
	Abbreviations, Equivalents and Definitions	" 12

LIST OF ILLUSTRATIONS AND MAPS

Spruce planted under Poplar

Frontispiece

PART I - LAND USE AND FORESTRY

ILLUSTRATIONS

Follows
page

Bedrocks of the Animikie	2
Soils developed over the Neebing Plain	2
Upstream the flow of the river is small	2
The imperfectly drained sand plain	7
Some farms on good land have been abandoned	7
Farm ponds can be constructed easily	7
Profile of gray-brown Podzolic soil	11
In the rock knob upland	15
Level, more fertile land	15
Well-drained rolling land	15
Grass is the chief crop in acreage	18
Many farms are not able to support a full program	18
Stacking the hay crop	18
Fuelwood cutting	22
The pulpwood market	22
Dairying is the backbone of agriculture	23
Root crops stored for winter use	23
Oats is the chief grain grown	23
Potentially arable land	24
Special land uses include excavation	24
Many areas in the watershed are posted	24
Spruce is in great demand	31
Jack pine on the sand plain	31
Too much scrubby poplar	35
Thinning of young stands	35
The tree farm certificate	42
Snow fences reduce wind velocity	42
The Dug-Out Pond (4 illustrations)	47
The Spring-Fed Pond (4 illustrations)	48
The By-Pass Pond (4 illustrations)	49
The Run-Off Pond (4 illustrations)	50
The Permanent Stream Pond (4 illustrations)	51
The Temporary Pond (4 illustrations)	52

MAPS

Proposed Enlarged Authority	2
Physiography and Municipalities	3
Present Land Use and Existing Woodland	21

	Follows page
Recommended Land Use including Recommended Authority Forest	28
<u>Graph:</u> Windbreak Plan	44

PART II - WATER

ILLUSTRATIONS

	Follows page
Fort William, April 1950	5
Balmoral Street flooded May 1950	5
Flood waters from the Neebing River	7
C.P.R. bridge downstream	7
April 1950, channel jammed by ice	8
C.P.R. bridge over the Neebing River	8
Flood waters on River Avenue	8
Flood waters on Alexandra and William Streets	8

MAPS

Neebing River Watershed	1
Water Level Profile	2

INTRODUCTION

Conservation has long been a subject of concern to the people of Ontario. This concern had to do originally with the protection of forests because of their importance as a source of revenue to the Province; but allied with this was the problem of wildlife management and the protection of source areas of rivers and streams. In Ontario interest in conservation was indicated first by reforestation and woodlot management, but more recently this has broadened out to include flood and pollution control, improved land use and provision for recreation facilities.

While the progress in these activities has been steady up to the present, most of the programs heretofore were initiated by government departments. Recently, however, there has been a growing conception of personal obligation, especially where land use problems, farm ponds and small reforestation projects are concerned. On the other hand, control of flooding, summer flow and pollution; large reforestation projects; and recreation areas have come to be considered the responsibility of the community - the community in this case being the river valley.

With the advent of this new concept of personal and community responsibility in conservation, the Authorities movement was born, and the willingness of our people to undertake conservation in this way is indicated by the fact that in the last ten years 17 Authorities have been established, with a total membership of 278 municipalities and an area of 12,217 square miles.

The first step in establishing a Conservation Authority is undertaken by all the municipalities wholly or partly within a watershed. Two such municipalities must first by resolution petition the government to call a meeting for the purpose of ascertaining whether or not an Authority should be established. Two-thirds of the number of representatives which the municipalities are entitled to appoint

(on a population basis) must be present to make the meeting legal. If two-thirds of those present vote in favour of establishing an Authority a resolution is forwarded to the Government. The Authority is then established by Order-in-Council and under the Act becomes a body corporate, including representatives from all the municipalities in the watershed.

While some Authorities were brought into being because of flooding within their areas, all were aware of the necessity of carrying out such supplementary measures as improved methods of land use, reforestation, proper woodlot management, prevention of pollution, investigation of underground water supplies, wildlife studies and recreation. But the Authorities were not equipped to carry out the extensive investigations that would indicate where such work should be done. Consequently the Conservation Branch of the Department of Planning and Development undertook to carry out the preliminary investigations as a service to the Authorities, to appraise, by means of surveys and reports, the conservation needs of each watershed, and to submit to the Authority a detailed report outlining the conservation measures that should be implemented.

The survey work is grouped under five general headings, namely, Land Use, Forestry, Water, Wildlife and Recreation. The scope of the studies made in each of these subjects varies with the condition and needs of the area under investigation. In addition to the five topics indicated above, a study of the history of the area is made. This serves as a backdrop to all the conservation problems of the watershed and compels the reader to understand the abuses of the past and the need for a diversified program in the future.

The starting point for all surveys is aerial photography. Before the survey is commenced in the field all such contributing data as maps, old records, photographs, unpublished reports and other useful information are thoroughly

explored and recorded. While the survey is in progress similar data are gathered locally, and agricultural representatives, zone foresters, municipal clerks and other officials and private citizens are interviewed for additional material.

The results of these conservation surveys, together with the recommendations based upon them, are set down in the reports presented to the Authorities and intended to serve them as a blueprint. The carrying out of any scheme is not the work of the Conservation Branch of the Department of Planning and Development, because it is not an operating department. Its active participation for the most part ceases when the planning is complete and the report is submitted, although it stands by to interpret the report and give advice and assistance in carrying out the plans recommended in the report. The Authority must assume responsibility for initiating the schemes which it considers most urgent; it must also make approaches to the government departments or other bodies from which it hopes to get assistance.

If, for example, an Authority undertakes a scheme having to do with land use, it must seek assistance from the Department of Agriculture; if it involves a forestry or wildlife problem, then the Department of Lands and Forests is approached. In the case of flood control, however, as there is no department of the Government doing hydraulic surveys except the Conservation Branch, whose staff is not large enough to carry through the engineering works of several Authorities, the Authority must engage a consulting engineer to do the final engineering and designing and to carry the work through the construction stage. Similarly, where an Authority undertakes a scheme which has to do with recreation, it may have to employ men specially trained in this work.

As the work being done by Authorities is a new approach to the conservation problem, in that the responsibility

of carrying it out is left entirely in the hands of the Authority concerned, much directing and assistance have been necessary from the Conservation Branch and, in the case of 14 Authorities, a member of the staff of the Department of Planning and Development has been assigned to work in the watershed.

The Neebing Valley Conservation Authority was established by Order-in-Council on July 15, 1954, following an organization meeting which was held at Murillo on March 10, 1954, when 8 representatives out of a total of 8 attended the meeting and 8 voted in favour of establishing the Authority.

As mentioned above, the Department of Planning and Development, as a service to an Authority, undertakes to carry out a conservation survey of the valley for the guidance of the Authority, but the commencement of conservation work in the valley does not necessarily have to wait until such a survey has been made and the report presented. This has been the case with the Neebing Conservation Authority, and much excellent work and planning have been done independently of the reports which have been prepared by this department.

The reports for the different sections of work for the Neebing Authority are: Land Use, Forestry and Water. These three reports are here presented in one volume.

- A. H. Richardson

RECOMMENDATIONS

RECOMMENDATIONS
STATED OR IMPLIED IN THIS REPORT

1. That, in view of the fact that the Conservation program of the Authority would be carried out more easily, effectively and economically if the Authority area was enlarged, the Neebing Authority be extended to include the watersheds of McIntyre Creek, McVicar Creek, and the Current River. p. 2
2. That the Authority encourage landowners to make greater use of the soil testing, farm planning, woodlot inspection and other services and assistance provided by the Authority and the several departments of government involved in resource management. p. 34
3. That the Authority encourage pasture improvement and to this end consider setting up a pasture improvement demonstration project. p. 41
4. That the planting of windbreaks be encouraged. p. 45
5. That the Authority encourage the building of farm ponds and offer assistance if and where this seems desirable.
p. 47
6. That the Authority keep in mind the possible future recreation needs of the people in the area and plan that, if desirable, Authority land may be used additionally for recreational purposes. p. 57
7. That the Authority encourage the orderly development of new agricultural land in accordance with the capability of the land. p. 42
8. That the Authority sponsor one or more projects, such as school scrapbook competitions and school tree-planting days, aimed at publicizing the need for conservation of resources in the watershed, and in educating the public as to what these needs are and the part they can play.
p. 34

9. That the Authority encourage the reclamation and control of gullies by providing engineering service and construction equipment. p. 42
10. That the Authority offer a subsidy to encourage reforestation of open land and underplanting of present stands to improve their composition. p. 37
11. That the Authority assist in promotion of the Tree Farm movement to recognize and publicize good woodlot management. p. 38
12. That the Authority commence land purchases for the Neebing Authority Forest and make regular additions to its holdings until the recommended area of 11,410 acres is acquired.
p. 38
13. That the Authority develop a part of the proposed Authority Forest adjacent to a well-travelled road for group demonstration to encourage the better management of private woodlands. p. 36
14. That the Authority urge and assist the Department of Lands and Forests to carry out experiments in improved planting methods and woodland management on the Authority Forest to provide a further guide to private owners in the management of their own woodlots. p. 40

CHAPTER 1
GENERAL GEOGRAPHY

1. Location and Area

The Neebing River is a small stream located in the District of Thunder Bay in north-western Ontario. It drains an area of approximately 55,800 acres and flows into Thunder Bay on Lake Superior. The river and its tributaries drain parts of the townships of Shuniah (McIntyre), Oliver, Paipoonge, Neebing and Ware and portions of the cities of Fort William and Port Arthur. It enters the lake about one quarter-mile north of the Fort William - Port Arthur city line

TABLE I
MUNICIPAL ACREAGE DRAINED BY THE NEEBING

Municipality	Area in Watershed	
	Acres	Per Cent
Shuniah (McIntyre) Twp.	18,412	33.1
Neebing Twp.	6,663	11.9
Oliver Twp.	18,594	33.1
Paipoonge Twp.	6,630	11.9
Ware Twp.	1,278	2.3
Fort William- Port Arthur	4,256	7.7
Totals	55,833	100.0

The watershed is reasonably well served by roads and most are kept in good condition. It contains segments of three highways - the Trans-Canada, and Provincial Highways 17A and 61. The Trans-Continental line of the Canadian Pacific Railway passes through the Lakehead and the Canadian National also serves the area. Both cities are provided with good harbour facilities which together handle over 6,000,000 tons of shipping per year. Grain, iron ore and wood products comprise the bulk of the cargoes.

The Lakehead is relatively isolated from urban neighbours of any size; Toronto is about 1,000 miles distant by rail and Winnipeg over 400 miles.

A large portion of the built-up section of Fort William lies within the boundary of the Neebing but apart from this there has been no other urban development of consequence. Murillo, Intola and Rosslyn Village are mere hamlets, while Baird and Morgan Station are names attached to places which no longer exist.

The Neebing Valley Conservation Authority has jurisdiction in conservation matters over the Neebing Watershed which covers 86 square miles of territory.

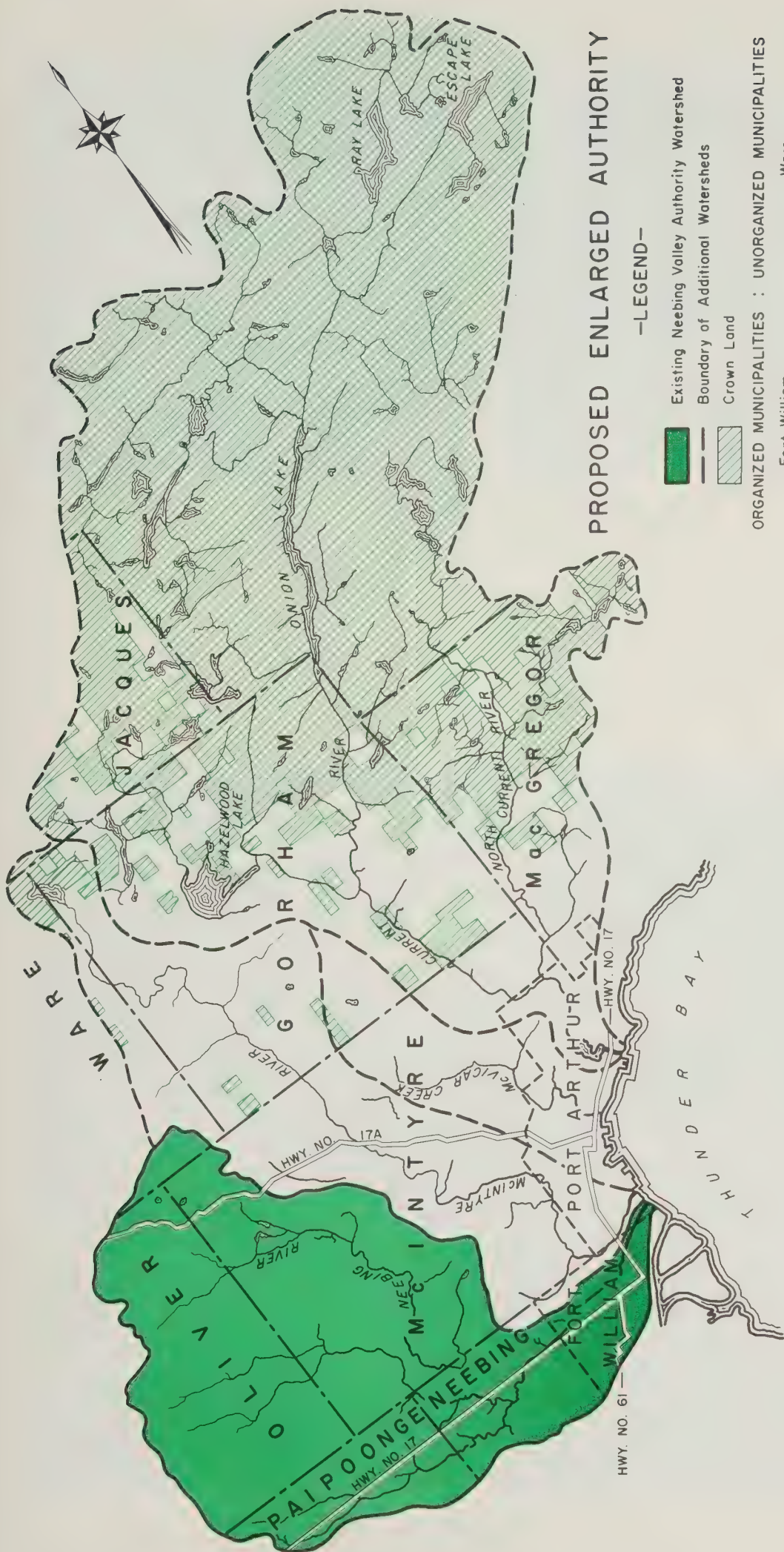
This is the smallest of all the Authorities in Ontario, and experience has shown that it is difficult for small Authorities to operate effectively. For this reason several Authorities, such as the Big Creek Region and the Metropolitan Toronto and Region Authorities, have been formed so as to combine a number of watersheds under one Authority.

It is therefore recommended that the present Neebing Authority be extended to include the watersheds of McIntyre Creek, McVicar Creek and the Current River. This would give the Authority control of all streams which cause flooding in the Cities of Fort William and Port Arthur.

No new organized municipalities would be added to the Authority but the expanded area would take in all of the Twin Cities and considerable areas of unorganized territory. There is some Crown land in the unorganized townships of Ware, Gorham and Jacques; most of the township of MacGregor (Shuniah) is Crown land and the whole of the unnamed unorganized territory embracing the upper part of the Current River Watershed is Crown land. The Authority area would be increased about five times.

TABLE II
WATERSHED AREAS

Watersheds	Square Miles
Neebing River	85.9
McIntyre Creek	59.5
McVicar Creek	19.4
Current River	253.8
Total	418.6



PROPOSED ENLARGED AUTHORITY

—LEGEND—

- Existing Neebing Valley Authority Watershed
- Boundary of Additional Watersheds
- Crown Land

ORGANIZED MUNICIPALITIES : UNORGANIZED MUNICIPALITIES

- Fort William
- Port Arthur
- Neebing
- Poigoonge
- Oliver
- Shuniah
- (MacGregor & McIntyre)
- Ware
- Gorham
- Jacques





Bedrocks of the Animikie series are often close to the surface and make cultivation difficult or impossible.



Soils developed over the sands and gravels of the Neebing plain are droughty and infertile.



Upstream the flow of the river is small but it often cuts through the sedimentary rocks.

TABLE III
MUNICIPAL AREAS

Territory	Square Miles		
	Present Authority	Addition	Enlarged Authority
Fort William	6.3	0.5	6.8
Port Arthur	0.2	14.2	14.4
Neebing	10.2	0.5	10.7
Oliver	28.8	-	28.8
Paipoonge	10.2	-	10.2
Shuniah (McIntyre and MacGregor)	28.3	76.3	104.6
Ware (unorganized)	1.9	3.9	5.8
Gorham "	-	73.6	73.6
Jacques "	-	17.3	17.3
Unorganized and unnamed	-	146.4	146.4
Total	85.9	332.7	418.6

2. Bedrock Geology








Perhaps the most important factor governing the development of the Neebing Watershed, and certainly of the Lakehead region, is the fact that the bedrock is almost everywhere at or near the Surface. There is an insufficient acreage of rock-free land to support an extensive agriculture. For relatively few miles west and south-west of Fort William there are comparatively thick deposits of glacial and post-glacial sands, silts and clays. Elsewhere the unconsolidated materials are found chiefly in pockets between the rocky ridges or as a veneer over the rock. The effect of this on agricultural progress has been important.

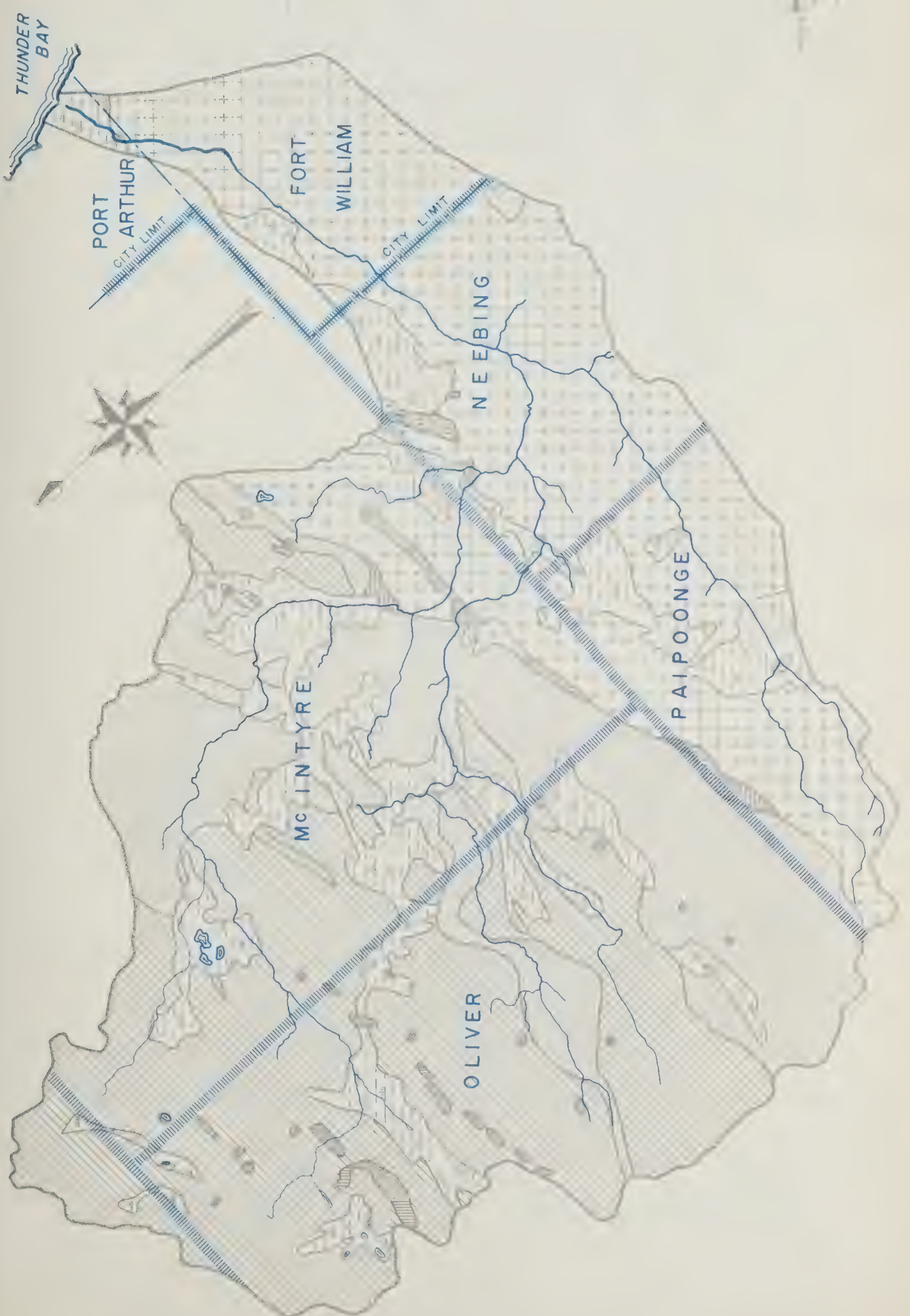
A very large part of Canada is underlain by rocks of the Precambrian complex; they are among the oldest on earth. This complex, commonly called the Canadian Shield and covering an area of many thousands of square miles, extends from the McKenzie River Valley in the far north-west deep into eastern Canada. It includes most of Northern Ontario.

Much of the Shield is composed of granite and gneiss but a great deal of the rock is sedimentary or the product of lava flows. The Shield is rich in minerals,

PHYSIOGRAPHY and MUNICIPALITIES

— LEGEND —

-  LAKE
-  RIVER
-  STREAM
-  ALGONQUIN LAKE PLAIN
(Sands, silts and clays)
-  AREA
(Sands, and gravels)
-  GLACIAL TILL
-  THUNDER BAY



THUNDER CAPE MAP - AREAS, THUNDER BAY DISTRICT, ONTARIO.

scenery, water and forest wealth but the poor soil development, coupled with a generally rigorous climate, inhibits agriculture.

The elevation of the Shield is moderate and the surface extremely uneven although generally devoid of high hills and great valleys.

The bedrocks of the Lakehead area are part of this complex. Most of the Neebing Watershed is underlain by Late Precambrian sedimentary strata of the Animikie series.* These strata are quite varied and include inter-stratified sandstone and conglomerate, a ferruginous chert rock commonly known as iron formation, and also shales and dolomite. A series of drill holes run in Shuniah Township some years ago revealed an iron content in the iron formation ranging from 5 - 40 per cent.†

A diabase sill similar to that which caps Mt. McKay lies within the eastern border of the watershed north of the Dawson Road. It is near the surface and soil development is poor. Early Precambrian granites are found around Intola and from here in a narrow band to the south-west. In the area west of Intola and north and south of the Dawson Road is found a complex of schistose rocks. These rocks pre-date the granites but the topography is similar.

3. Glaciation

In common with most of northern North America the present Neebing Valley was covered by the several continental ice sheets, the last of which, the so-called Wisconsin, disappeared only a few thousand years ago.

This ice stripped from the bedrocks their existing soil cover, distributed that cover near and far, scoured the bedrocks, deranged the existing drainage pattern and created, or helped to create, new land forms. In the Neebing Watershed, as elsewhere in the Shield, the rock knob

* Animikie = Thunder (Indian)

† Tanton, T.L., Geol. Sur., Canada, 1931, Mem. 167.

upland became a land of lakes, many of which have since been filled by vegetation to form marshes and bogs.

During and after the retreat of the Wisconsin ice there developed the great glacial lakes. Many of these lakes were as large, or larger than, the present Great Lakes. Lake Algonquin covered, for instance, all of present Lakes Superior, Michigan and Huron, and much additional territory besides. The waters of this lake flooded a considerable amount of land at the Lakehead and many of the beaches and terraces it constructed are still visible far above the present lake level.

Tanton suggests that the broad valley of the old Kaministikwia River developed in pre-glacial times, was broadened and deepened by the ice, and subsequently more or less filled by glacial debris (i.e., by till, an unstratified mixture of sand, silt, clay and stones).*

During the time of Lake Algonquin, when the area west and south-west of the Lakehead formed an embayment in the lake, the ice meltwaters provided a full-flowing Kaministikwia River which carried large amounts of sediment. On reaching the lake these sediments were dropped to form a delta of considerable thickness. West of Fort William the surface deposits are chiefly stratified sands and gravels but clays are more important in the Slate River area.

Further north in the Neebing Watershed non-lacustrine fluvial materials are found in a band of country several miles wide and extending through Murillo, Baird and Morgan Station. North of these outwash deposits, but also interspersed in them as islands and peninsulas, are deposits of sandy, stony till.

Throughout the watershed poorly drained areas are common. Some of the largest are found on the sand plain. These depressions are usually filled with peat and muck of variable depth.

* Tanton, T.L., Geol. Sur., Canada, 1931, Mem. 167.

4. Hydrography and Water Resources

(a) The River

The main branch of the Neebing River rises north of Intola in the rock knob upland, from whence it flows south over a wandering course to Lot 20, Concession III, Neebing Township, where it takes an easterly course to the lake.

There are two major tributaries to the Neebing. Pennock Creek finds its headwaters near Murillo and flows some 8.5 miles south-easterly through a sandy plain to join the trunk stream west of the Fort William airport. The other tributary rises several miles north of Murillo and also flows south-east to join the Neebing a short distance upstream from where Pennock Creek makes its entry.

The watershed attains an elevation of well over 1,300 feet above sea level in its northern reaches and only a little over 600 feet above sea level at Thunder Bay. The river drops, therefore, a distance of some 700 feet over a straight-line course of perhaps 20 miles. Nearly all of this fall takes place in the upper and middle portions of the watershed; through the sandy plain the fall is only 50 feet or so over a distance of perhaps 8 miles from the river mouth,

The Neebing Valley is a recent development, geologically speaking, and the river is actively engaged in downcutting. Upstream from the river mouth the unconsolidated sediments of the plain are easily eroded and the stream has developed a deep watercourse of low gradient. Along this portion of the valley gullies of considerable size are cutting back into the plain.

Further upstream the unconsolidated veneer is much thinner and the bedrock is a persistent obstacle to rapid downcutting. In places, where the river encounters sedimentary rock strata, some gorge development is taking place. Along much of the stream course there are many waterfalls and rapids

(b) Municipal Water Supply

Unlike many municipalities Fort William is in an extremely favourable position with regard to its water supply. The Loch Lomond reservoir area, acquired by the City a number of years ago, has assured the City of adequate amount of fresh, clean water suitable for all domestic uses. Strict control of the lake and its watershed by the Corporation ensures a continuance of this favourable position in perpetuity. Viewed in terms of present population and water use it would appear that the reservoir will be able to supply the City with adequate amounts of water under any foreseeable increase in population or demand.

This favourable picture with reference to Fort William water supply makes it unnecessary for the City to depend on subsurface supplies or on the Neebing River. Also, should the municipality at some future date need to augment its supply from elsewhere it would, in all probability, turn to Lake Superior. The City of Port Arthur is supplied from this source. Such a position is a contrast to many towns and cities elsewhere which depend on subsurface or river waters entirely.

Should the Neebing Authority proceed on a program of structural control of the Neebing River, the provision of water for domestic use will not be a matter of concern. The river is important to the City, however, in the disposal of sewage and control of river flow will undoubtedly be an advantage with respect to the satisfactory elimination of these wastes. Control of the river would also provide a solution to the flood problem in the City.

(c) Rural Water Supply

Away from the area serviced by city mains all domestic needs, and in many cases those of livestock as well, are supplied by subsurface waters. Surface supplies from streams and ponds are also used by livestock wherever available.



The imperfectly drained sand plain west of Fort William.



Some farms on good land have been abandoned.



Farm ponds like this can be constructed easily and cheaply.

The use of increasing amounts of water for domestic purposes has in many cases led to a search for more substantial supplies than can be obtained from shallow dug or drilled wells. These supplies have been reached often by the expedient of substantially deepening existing wells. These and other drilled wells sometimes attain a depth of well over 100 feet before suitable supplies are found. In nearly all cases of record these waters come from gravel and sand layers of glacial or pre-glacial origin. In some cases the bearing formation is apparently glacial till. All of the recorded wells require pumping.

5. Climate

In terms of agriculture the Neebing Valley suffers the disadvantage of possessing a fairly rigorous climate. In this matter it is similar to most of Northern Ontario but, because of its proximity to the lake, conditions are perhaps not as harsh as those which prevail at some points.

Climatic statistics are not available for the Neebing Valley but information does exist for Port Arthur and Kakabeka Falls. Examination of these records reveals a significant difference in climate between these two places although they are separated by a distance of only 18 miles. The generally milder conditions at Port Arthur can be attributed to the influence of the lake. It can be expected that conditions in most of the valley would be intermediate to those found at the stations to either side.

The influence of the lake at Port Arthur and the greater "continentality" of the climate at Kakabeka Falls may be seen in the average daily maximum and minimum temperatures. With reference to the minimum, Port Arthur is 5 degrees warmer over the year and 2-8 degrees warmer on a monthly basis. The maximum for the year at the Falls is 2 degrees higher than Port Arthur, except in the three winter months when the lake influence is felt and the average daily

TABLE IV

MONTHLY & ANNUAL AVERAGE OF MEAN TEMPERATURE & PRECIPITATION

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	YR.
Port Arthur Temp.	7	9	20	35	47	57	63	60	53	42	27	14	36
Precip.	.91	.76	.95	1.49	2.11	2.81	3.56	2.78	3.37	2.45	1.52	.95	23.66
Kakabeka Temp.	2	6	18	35	48	58	64	61	52	40	26	10	35
Falls Precip.	1.35	1.19	1.56	1.62	2.16	2.78	3.43	2.73	3.36	2.32	1.82	1.57	25.88

Temperature - Degrees Fahrenheit

Precipitation - Inches (including snow in water equivalent)

maximum temperature is higher at Port Arthur. In effect the lake acts as a thermostat to reduce the temperature range.

The mean date of the last occurrence of a 32 degree temperature in spring in the valley is June 7, and the first occurrence in fall is September 7. The mean frost-free period is thus about 90 days. The length of the growing season (average temperature above 42 degrees) is about 160 days. In Southern Ontario the frost-free period ranges from 30-70 days longer.

The annual precipitation averages about 24 inches, of which about 5 inches comes in the form of snow.* The average annual precipitation is thus about 3 inches greater than at Winnipeg and 8 inches less than at Toronto.

The Lakehead receives a little less precipitation than does Cochrane in the Great Clay Belt, although the rainfall in both areas is about the same in the period July-September. Rainfall at the Lakehead during this period is more irregular, however, and there is less interference with harvest operations.

Generally speaking the climate of the area favours the production of many of the common field crops - including oats, barley, flax, potatoes and alfalfa - and common garden vegetables - including carrots, cauliflower, cabbage and turnips. Some of the small fruits may also be grown successfully. Those crops requiring a longer growing season and higher average temperatures, and which are susceptible to frost, cannot be grown successfully, although experimentation is lengthening the list of suitable varieties.

* 10 inches of snow is calculated to equal one inch of precipitation as water equivalent. Snowfall at Port Arthur averages 42.9 inches, and 65.7 inches at Kakabeka Falls.

6. Soils

(a) Introduction

Every farmer knows that not all soils are the same and that in any given area some may be stony, some shallow, some dry, some wet and so on. He also knows that not every piece of land produces crops equally well, even on his own farm, although he may not be too sure of the reason.

If land (or soil) can vary in quality and characteristics in a small area it is reasonable to assume that it does so over a wider area. In Ontario this is found to be the case, even though at places far apart the materials forming the soil and the mode of origin of those materials may be the same or very similar. This fact was not always recognized and many people assumed, and many people still do, that because the clay lands of Northern Ontario, for instance, appeared to be like those of Southern Ontario, they would be equally fertile and would support a similar agricultural development. Time has shown the fallacy of this opinion and scientific research the answer to why this is so. A thick organic top layer to the soil does not necessarily indicate fertility.

Soil, as described by the scientist, is a complex natural body and the outcome of many factors and processes working over a period of time. It is not simply the stuff in which plants may or may not grow. Nor is it more than a few feet deep at the most, although it may be underlain by tens or hundreds of feet of unconsolidated materials.

If considered in a broad way most of the well drained soils in Ontario may be grouped into three great classes. To those of Northern Ontario the term Podzol has been applied, and to those of Southern Ontario the term Grey-Brown Podzolic. Between these two groups, in the southern part of the Shield between Sault Ste. Marie and Ottawa and in a broad band of country west of the Lakehead there is a zone

of soils to which the term ~~Brown~~ Podzolic has been applied. These soils are transitional between those of the other two zones. The Zonal soils are the "normal" soils which develop in those zones under conditions of good drainage and under the prevailing regional climate and natural vegetation. They are in equilibrium with these factors. Elsewhere on the earth the same kind of zonal soil develops provided the same environmental factors prevail.

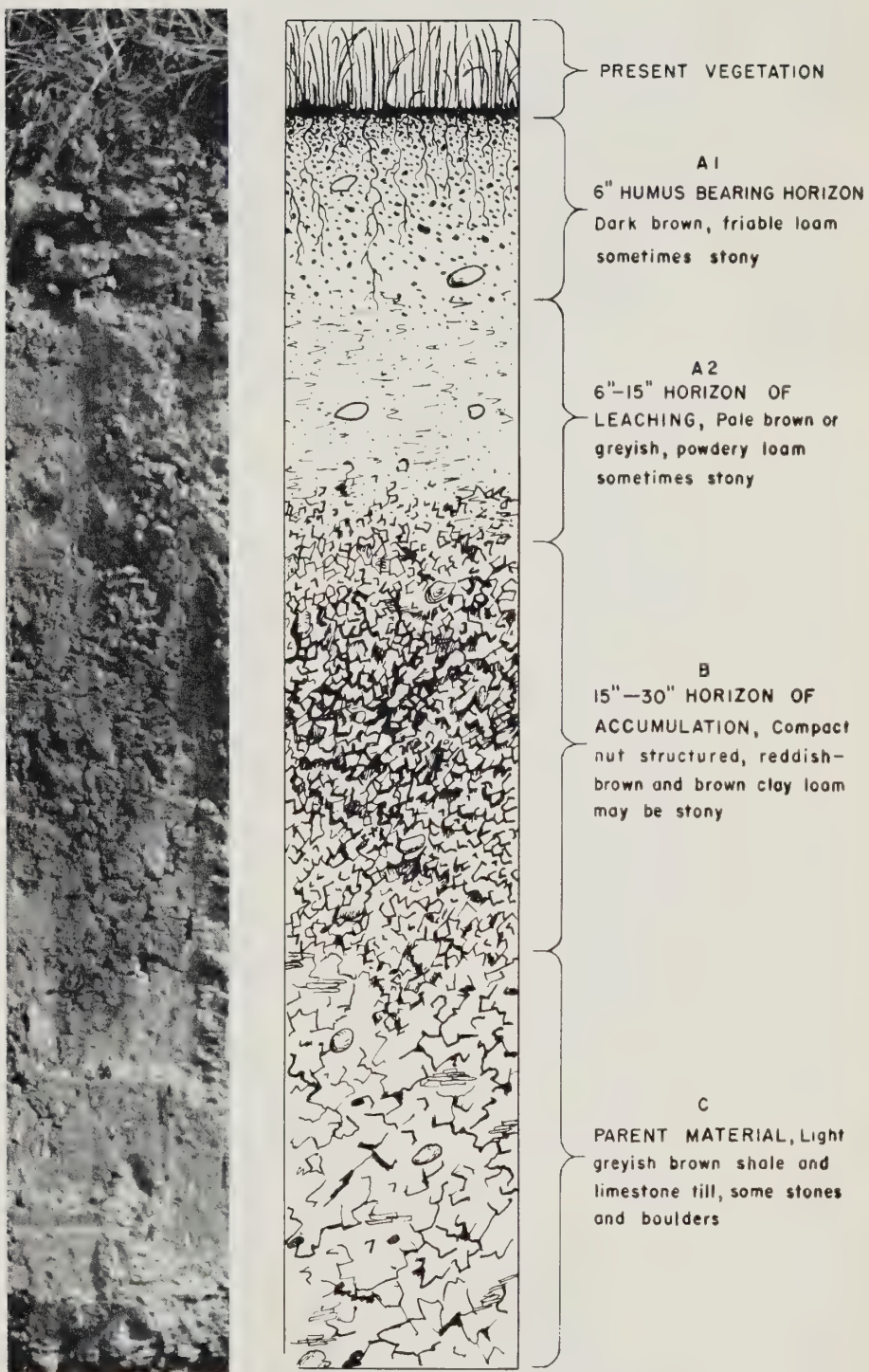
But there are soils within these zones whose development is not characteristic of any one zone; they may be found in more than one zone. Because of locally very wet or very dry conditions, very steep slopes or a shallow regolith* (or none at all) the normal zonal soil may not be able to develop, although other classes of soil may be able to develop. Such soils are classed as Intrazonal (those developing due to local conditions of climate, relief, etc.) or Azonal (those slightly or undeveloped due to local conditions).

Within the Neebing Watershed representatives of most of these soil groups may be found. The bog soils represent the Intrazonal, the blow sands the Azonal, and the loamy soils of good drainage the zonal Brown Podzolics. Where found the podzols are poorly developed representatives of their group. The climatic factor restricts the development of the Grey-Brown Podzolics.

(b) The Soil Profile

Soil mapping and description on a broad scale such as outlined above, and on a local scale, is carried on according to the soil profile. If a vertical cut is made to a depth of several feet through a well drained soil in the Podzol Zone it will be seen that the cross-section exposed is marked by a layering, each layer, or HORIZON, possessing certain characteristics of colour, texture, structure, organic

* Regolith - unconsolidated cover over the bedrock.



Profile of a representative gray-brown podzolic soil.

content, acid reaction and so on. Together these horizons make up the soil PROFILE. The depth of the profile varies from soil to soil and from zone to zone.

In the podzol profile it will be seen that the top inch or so of the soil is composed of black organic material in various stages of decay, the upper portion being in a rawer condition than the lower which is more humified. It will include twigs, leaves, needles and so on. This horizon may be designated as the A1.

Beneath the A1 horizon will be found a light grey layer which is heavily leached but high in silica. This is the so-called "ashy" layer which is typical of the podzol. It may range from 1-18 inches in thickness. Usually it is only a few inches thick. This horizon is called the A2.

Next, a brown-coloured horizon containing much clay is found. This is the B horizon. It is a layer of accumulation, hence the clay, and is rich in plant nutrients.

Below the B horizon is the C horizon, or parent material. These materials are largely unweathered and may or may not be fairly rich in lime.

Although the horizons may be quite distinct it will be seen that there is no sharp line separating one from the other, rather there are zones of transition.

The Brown Podzolic and the Grey-Brown Podzolic soils exhibit profiles similar to that of the Podzol but there are some important differences. The first-mentioned soils develop under less rigorous climatic conditions and a more strongly deciduous forest vegetation. This, combined with increased soil bacteria and fauna activity, helps to produce a deeper profile. The A1 horizon also becomes less peat-like as humification of the organic material increases. The A2 horizon, instead of the ash-grey of the podzol, becomes brown to greyish brown and tends to thicken. The B horizon may thicken considerably and usually displays less tendency to form a hard pan.

There is one other difference, all important to the farmers, in these soils. Because of moderating climatic conditions, a different type of vegetation and less intense leaching, there is commonly a marked increase in fertility as one goes from the Podzol through to the Grey-Brown Podzolic. The production capabilities of the Grey-Brown Podzolics can be very high under good management while only medium for the Podzols at best. The Brown Podzolics are more fertile than the Podzols but a highly successful agriculture can be developed only if sufficient supporting markets are available and if the extent of usable soil is adequate. In both of these respects the Lakehead appears to be at a disadvantage.

The intrazonal and Azonal soils are important in the Neebing Watershed simply because they occupy a considerable acreage. It seems hardly likely that they will be important to agriculture for a long time to come, if ever. If an increased market demanded it, some of the peat and muck deposits might possibly be used for vegetable or general production. Drainage would be necessary, of course, and it is highly likely that heavy applications of lime would be needed. The shallow and rocky soils should be returned to forest.

The bog soils are found in low-lying areas where a persistently high water table has favoured the accumulation of organic material. This layer is usually quite woody and acid and may be several feet thick. Beneath the peat layer is found the glei horizon, a bluish or greenish coloured layer which is rather plastic when wet. It may be mottled with rust coloured streaks and blotches. Some of the peat deposits west of Fort William are fairly deep.

Intermediate between the well and poorly drained soils are those which may be classed as imperfectly drained. These soils are affected by a moderately high and fluctuating water table. They are usually less productive

than the well drained soils, chiefly because of the water problem. They are identified in the field by the rusty mottling which may be seen in the lower part of the A2 horizon and in the B horizon.

(c) Soil Mapping

The Dominion Experimental Farms Service and Ontario Agricultural College have been jointly responsible for the mapping of Ontario soils, by counties, since 1935. In Southern Ontario, and recently in the New Liskeard - Englehart area, the soils have been mapped according to the catena, series and type. A catena includes those soils which have developed in the same type of parent material but which differ in profile characteristics because of drainage or topographic conditions. Each catena might include well, imperfectly and poorly drained members. Each member is designated as a series and each series includes one or more types. Soil mapping is done chiefly on the basis of the type which is differentiated according to the texture of the surface soil.

The Huron catena, for example, has developed in Southern Ontario on a heavy textured limestone till. Within this catena are the well drained Huron series, the imperfectly drained Perth series, and the poorly drained Brookston series. The Huron series contains two types, the Huron clay loam and the Huron silt loam, but might contain more. The same is true for the Perth and Brookston series. Where a local condition, such as stoniness, would be important to agriculture the soil may be designated as a phase. There might thus be Huron clay loam, stony phase. Soils are mapped chiefly on the basis of the soil type.

While the soils of Southern Ontario have been so mapped, those of north-western Ontario have been treated differently for a number of reasons. Mapping in this area has been done on the basis of the land type; it is more generalized than mapping according to the soil type and phase

but is quite suitable for descriptive and broad planning purposes.

"Local variations within the broad regional soil divisions are associated with differences in geological materials, topography, drainage and accompanying variations in local climate and vegetation."

"On the more detailed soils surveys all of these variations can be taken care of through the use of mapping units such as soil types and phases. On the broader surveys more of these soil conditions must be grouped for mapping purposes and the soils separated on the basis of only one or two factors. It is evident that these factors will be determined largely by the character of the land to be mapped and will not always be the same. The land type is the mapping unit used, and it represents any range of soil conditions which occurs repeatedly over an area. Frequently the type of geological material is the most uniform factor within an area mapped as a land type, while the range of drainage and of topography is comparatively wider. There is usually a much wider range in the soil profiles within a land type than within a soil type."*

Within the Neebing Watershed the land types represented are briefly discussed in Table V.

(d) Soil Erosion

Almost everyone is aware, if only in a vague way, that soil erodes and that the eroded material is carried downstream to fill reservoirs and cover bottomlands, or to find its way to lake or sea. Even the most unobservant has seen chocolate-coloured creeks and rivers, burdened with silt and clay, after a long or heavy rain. Likewise, the clear and sparkling waters flowing through well managed or undespoiled areas are known and appreciated.

Erosion of the land is a natural process, perhaps even beneficial insofar as crops are concerned, for a small loss from the surface soil is made up by an increment from below as the parent material weathers and is incorporated into the soil. However, under natural conditions this process is a very slow one and it takes a long time for it to change

* Hills, G.A. & Morwick, F.F. Reconnaissance Soil Survey of Parts of Northwestern Ontario. Report No. 8 of the Ontario Soil Survey. Guelph, 1944.

TABLE V (PART 1)

LAND TYPES ON THE NEEBING WATERSHED

Land Type Character- istics	L A N D T Y P E S		
	Oliver	Slate River	Rosslyn
PARENT MATERIAL	Grey-Slaty, Stony Loams	Deltaic Fine Sands, Loams & Silts over Clay	Deltaic Sand & Gravel
NATURAL FOREST	Maple, Birch White Spruce	White Spruce, White Birch, Aspen, some Elm	Chiefly Jack Pine
DRAINAGE	Generally Good	Variable	Generally Excessive
TEXTURED CULTIVATED SURFACE	Loam, Silt or Clay Loam, often Stony	Variable	Sand Loamy Sand
REACTION CULTIVATED SURFACE	Medium Acid	Slightly to Strongly Acid	Acid
PROFILE DEVELOPMENT	Weak	Fair to Good	Weak Podzol
TOPOGRAPHY	Undulating	Gently to Strongly undulating	Smooth to Gently Undulating
FERTILITY	Fairly Good Deficient in Phosphorus & Potash	Variable	Low
AGRICULTURAL DEVELOPMENT	Fair - Dairying	Fair on the Better Land	Small Amount. Proximity to Lakehead Cities governs use.
POTENTIAL FOR AGRICULTURE	Good for the Area	Fairly Good where Land not too rough	Low, but useful for Specialized crops on Small Holdings

TABLE V (PART 2)
LAND TYPES ON THE NEEBING WATERSHED

Land Type Character- istics	L A N D T Y P E S			
	Neebing	McIntyre	Undifferentiated	
			Shallow over Bedrock	Deep Peat Bogs
PARENT MATERIAL	Deltaic Coarse & Fine Sand	Shallow Lacustrine Sand & Gravel over Slate	Open Bedrock Stony Till Some Outwash	Peat
NATURAL FOREST	Black Spruce Balsam Fir Tamarack	Birch & Aspen	Variable - Depends on Drainage	Black Spruce Tamarack Sphagnum Moss
DRAINAGE	Poor to Very Poor	Variable	Excessive to Poor	Very Poor
TEXTURE CULTIVATED SURFACE	Organic	Coarse	Variable	Organic
REACTION CULTIVATED SURFACE	Acid	Medium Acid	Strong to Medium Acid	Medium to Strongly Acid
PROFILE DEVELOPMENT	None except where Peat thin	Shallow Indistinct	Weak or Undeveloped	None
TOPOGRAPHY	Smooth	Undulating	Rock Knob	Smooth
FERTILITY	Low	Medium to Low	Low	Low
AGRICULTURAL DEVELOPMENT	None	Moderate - Part Time & Garden Crops	Low	None
POTENTIAL FOR AGRICULTURE	Low - Best in Trees	Low - Proximity to Lakehead Cities Governs Use	Low	Low



In the rock knob upland arable land is scarce and a more complete integration of farm and forest is desirable.



Level, more fertile land as in northern Paipooonge Township is capable of supporting a more diversified agriculture.



Well drained rolling land in Oliver Township capable of producing good crops. Swampy hollows and rock outcrops are the chief problems to cultivation.

the landscape appreciably. We call it geologic erosion.

When the land is cleared of its protective cover of vegetation and devoted to cultivation or grazing the picture may be changed radically. As the land is cultivated the soil structure may be changed, often for the worse, and the organic content and water absorbing capacity may be reduced. The land is often overgrazed and cultivation is carried on up and down the slope. All this helps the water to run off the land at a faster rate with the result that the soil, built by nature over the centuries, may be ruined or made less productive in a remarkably short time. This is called accelerated erosion and it is the type that agriculturists and conservationists are concerned about.

On the Neebing Watershed there are two main types of erosion resulting from water - gully erosion and sheet erosion. Wind erosion is not a factor of great importance in the area.

Gully erosion is very destructive in a limited area and is easily recognized. It may occur for a variety of reasons:- run-off water may be channelled down the slope of a cultivated field or poorly managed pasture; it may develop where tile outlets are inadequately protected. Whatever the cause, gullies are difficult to deal with, particularly when they become large.

The start of a gully may often go unnoticed but it can enlarge rapidly. Small rills which may be found on the slope of a field after a heavy rain and which can be covered over at the first cultivation can easily lead to gully development. Gullies often develop in stream banks where the erosive action of the water is increased because of a great change in gradient and they can soon cut back across a field. There are quite a few of these along the lower Neebing and steps should be taken to control them.

Sheet erosion is not so easily recognized and is dangerous for this reason. It takes a little bit of the

surface at a time but the cumulative effect is great. It may affect a whole field although some parts will be eroded more than others. It usually proceeds slowly and the farmer is often unaware that it is taking place, except that he finds the land less productive and more difficult to manage.

Sheet erosion may take place on any sloping land but is often worse where the land is heavy. The open nature of the light soils normally permits more readily the penetration of water, thus helping to reduce surface run-off. Erosion may be serious on gently sloping land where the slopes are long and the water has a free flow. Steeper, more hummocky land may actually suffer less because the slopes are short. In many cases, however, erosion may have taken place into the parent material on the knolls.

Types of land use and methods of cultivation may also have great significance in the amount of erosion that takes place. Land kept under a permanent cover of grass or trees may erode very little. The same may be true on level lands regardless of the form of use although, of course, fertility levels may decline unless management measures are adequate. Intertilled crops such as turnips and potatoes afford very little soil protection and their cultivation should be restricted to the more level lands. Grain crops give more protection but land left fallow is, of course, almost completely unprotected.

While soil erosion on the Neebing Watershed might not be considered generally serious it is serious in some respects. Gully erosion along the lower Neebing has already been mentioned; gullies are also found elsewhere and should be dealt with. Sheet erosion is common wherever cultivation is carried on and in many places where it is not. There is a considerable acreage of land where the soils are shallow over bedrock and these pose a problem because erosion may soon remove the cover completely and render the land unfit for anything.

CHAPTER 2

LAND USE

1. Introduction

The Lakehead region has been known and occupied for many centuries, first by the Indian and for the past three centuries by the white man. For a long time after the first visit by Radisson and Grosilliers the agricultural possibilities of the area were ignored. Even after transcontinental transportation became a fact the area developed slowly; there were better farm lands further west to attract settlers.

The growth of Fort William and Port Arthur has been keyed to growth elsewhere and not to local regional developments, although these have been, of course, a factor. Although the potential acreage of agricultural land is considerable, the capability of this land is generally modest.

As the West developed and poured out its river of grain the Lakehead kept pace, for most of it went through the Twin Cities. By good fortune this area possesses the only substantial acreage of land suited to agriculture on the Ontario shore of Lake Superior. Here also were harbour facilities suitable for lake shipping; over the years these facilities have been improved to handle the large traffic. Water supplies and sites suitable for urban development were also adequate.

These factors made the Lakehead a natural break-point for water-rail traffic between Canada's East and West. On this the prosperity of the area depends. The local industrial development would not have taken place were it not for this relationship. In the case of pulp and paper, supplies of wood now come to the mills from a considerable distance; local supplies are of minor importance.

Several things hinder the expansion of agriculture in this region. The quality of the land (exceptions can be found) restricts severely the development of a

Grass is the chief crop in acreage on the watershed but the quality and quantity produced can be improved substantially.



Many farms are not yet able to support a full program of mechanization. This is a common method of dealing with hay on the watershed.

Stacking of the hay crop in the open is a common practice.



husbandry equal to that in more favoured sections of the Province. Climatic conditions, too, and an inadequate acreage of land easy to cultivate, are additional factors hindering successful development. This is not to say that a worthwhile agriculture cannot develop. It has, to a limited extent, and can, but under different terms and at a higher cost than is the case in most of Southern Ontario.

Limited markets and the ability of those markets to bring in foodstuffs from elsewhere more conveniently and at lower cost than they can be grown at home are difficult to overcome. Restrictive land and climatic conditions also make it difficult for the land to supply the desired living standards under existing tenure. In earlier days when wants were less than they are today, land like this was more able to support a farm family in moderate comfort. This it can no longer do, if on the Neebing it was ever able to, and most of the rural people must augment their income from work in factory or forest.

Witnessing the fact that the land could not support its people under existing tenure conditions are the many derelict and run-down farms and farm buildings. The Census of Canada records, for Thunder Bay District, an increase in occupied farm lands from 232,000 to 303,000 acres between 1921 and 1931, but a decrease to 278,000 acres by 1951. In the same periods the number of farm operators rose from 1,590 to 2,173 and then decreased to 1,863. The improved land has increased in acreage, however, suggesting the farmers have had to use their land more intensively.

2. Land Tenure

While the foregoing remarks apply to the Lakehead region as a whole they also apply to the Neebing Valley which forms merely a small part of this area. The problems facing agriculture in the valley are regional problems.

Additionally, the valley is influenced strongly by the growth of Port Arthur and Fort William. Both cities

have sent strong runners of urban development some distance along several of the roads through the watershed. Such agriculture as existed has consequently been broken by this urban growth and the pattern along these roads is one of small holdings of various sizes. Fortunately this spread has not been to the best of the agricultural land.

The watershed is fairly heavily populated with an estimated 38-40,000 people, perhaps 95% of whom live within the immediate Fort William area. Of the small balance perhaps only half are engaged in farming in any way. The non-farm group include retired farmers and city workers.

The full-time farm force is small and is located on the loamy soils along John Street, near Baird, and in the south-west on the silty soils of Paipoonge. The balance of the farm force follows agriculture only part of the time; with many the farm is simply a place to spend the summer. This group obtains a substantial portion of its income in the cities, on road work, in woods industries and in other ways.

" At the present time, this tendency to farm part-time and to spend part of their time in the bush, mine, factory, or at road-work appears to be in a degree, independent of the potentiality of the land for agricultural development. This can be seen by comparing O'Connor and Gorham Townships. In O'Connor we have, in the main, a poor part-time type of farming, though the land is potentially second or third rate and has been cleared of forest, even from the poorer slopes where it is needed. Several farms may be worked by a single operator who manages all of them on the same 'hay and pasture' basis as though he were working part-time at some other occupation. The net result is that the land is not any more intensively used and may even support fewer people per unit area than does Gorham township. In this latter township the land is but fifth or seventh grade, potentially, and is used on a part-time basis with almost every farm occupied." *

These remarks have considerable significance with respect to the Neebing Watershed.

* Hills, G.A. - The Role of Forestry in the Conservation of Settlement Lands in Ontario. Soil Research Brief #5. Ont. Dept. Lands & Forests. 1949.

According to the Census of Canada, 1951, the great preponderance of farms in the four townships of Oliver, Neebing, Shuniah and Paipoonge are owner-operated. Out of 929 farms in the four municipalities, 868 are in this class. The balance, 61 farms, are operated by tenants (19), tenant-owners (32) and farm managers (10). Any holding larger than 3 acres in size and on which agricultural operations are being carried out is considered as a farm by the Census.

The urban influence strongly affects the sizes of farms in those townships adjacent to the cities, and along the main roads leading out of the cities. In Shuniah Township nearly 68 per cent of the farms are less than 70 acres in size. In Paipoonge and Neebing over half of the farms are in this size group. In all four townships most of the farms are less than 180 acres in size, although there are quite a number containing from 240-399 acres. Oliver Township is, perhaps, more clearly rural than the others.

The present condition suggests, and past experience proves, that farms of small size in Northern Ontario are generally incapable of supporting a family in any degree of comfort without augmented earnings from off the farm. A farm-forest economy for Northern Ontario has been advocated by many people and there is reason to believe that such an operation in which husbandry of field and forest on the farm would be combined, would be suitable on much of the land at the Lakehead.

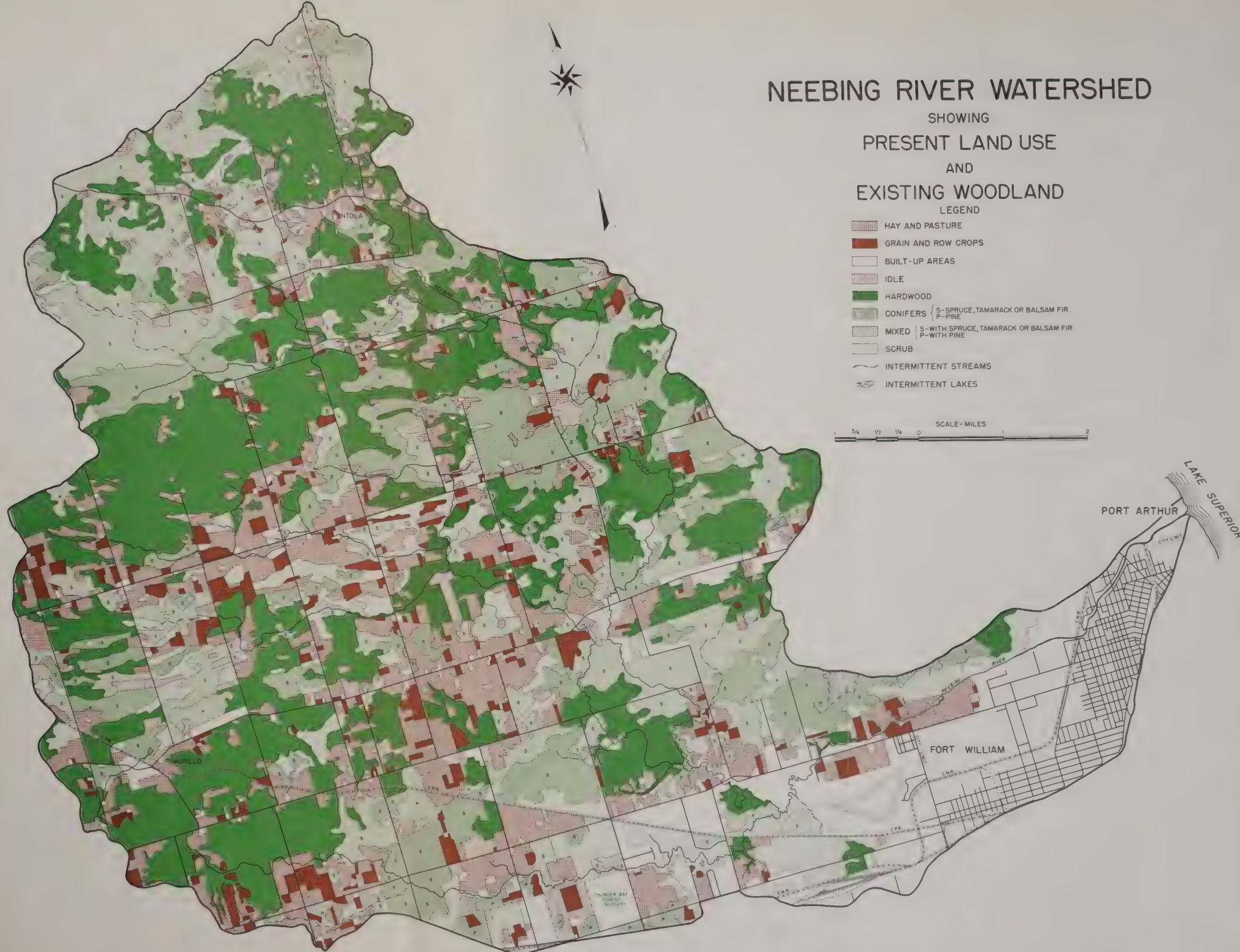
Under present conditions it is difficult to suggest what size a farm should be to be self-sufficient. This depends on many factors, including market availability, quality of the land and the distribution and acreage of that land, the ease with which the land may be worked, the type of farm economy and the skill of the farmer. Land development and maintenance costs are also important.

NEEBING RIVER WATERSHED

SHOWING
PRESENT LAND USE
AND
EXISTING WOODLAND

LEGEND

- HAY AND PASTURE
- GRAIN AND ROW CROPS
- BUILT-UP AREAS
- IDLE
- HARDWOOD
- CONIFERS { S-SPRUCE, TAMARACK OR BALSAM FIR.
P-PINE
- MIXED { S-WITH SPRUCE, TAMARACK OR BALSAM FIR.
P-WITH PINE
- SCRUB
- INTERMITTENT STREAMS
- INTERMITTENT LAKES



Even in an area as small as the Neebing Watershed the land conditions are of such a nature that not all farms should be the same size. It is believed, however, that on land of reasonable productivity and extent a farm should be at least 200 acres in size to present a fair return.

3. Land Use

During the survey of the watershed most of the existing land uses were mapped, some in more detail than others. A summary of land use is shown in Table VI.

TABLE VI
PRESENT LAND USE

Use	Acres	Per Cent
<u>CLEARED LAND</u>		
Grain (chiefly oats)	1,678	3.0
Hay and Pasture	9,346	16.7
Row and Market Crops (chiefly potatoes)	412	.8
Idle	1,098	2.0
Fallow	162	.3
Water	156	.3
Farm Bldgs. & Urban	7,284	13.0
	20,136	36.1
Forested Land	35,702	63.9
Total	55,838	100.0

No attempt was made to count the kind and numbers of livestock carried but it was clear that the organization of the valley's agriculture revolved around the dairy herd and the supplying of whole milk and cream to the urban market

Fuelwood cutting, if well planned, can improve the stand by removing the poorer trees.



The nearness of a pulpwood market can be a great advantage if stands are managed carefully and not slashed indiscriminately.

There is no beef industry in the area and only one beef herd was seen. The 1951 Census of Canada recorded a total of 3,955 dairy cattle in the four townships previously mentioned and only 249 animals kept primarily for beef. By far the larger number of dairy cattle were in Oliver and Paipoonge Townships and most of the beef were in Neebing and Paipoonge. These two townships also carried most of the sheep and hogs, although few of either were kept. Poultry are found in largest numbers in the townships of Shuniah, Neebing and Paipoonge and then chiefly where small holdings are common.

Dairying could be even more important than it already is but a restricted local market confines its development. The dairies in Port Arthur and Fort William have set quotas geared to their sales and the value of a farm is measured by its quota. There are no facilities on the watershed to handle surplus milk although a cheese factory at Stanley is sometimes opened to handle serious surpluses.

Although a considerable portion of the watershed will never be useful to agriculture because of poor drainage, thin soils and rough topography, there is considerably more land available to this industry than is presently used. Only 23 per cent is being used directly for agriculture, while nearly 64 per cent of the land is under a cover of forest or forest scrub and 13 per cent is in urban and other such uses.

Most of the bush is of poor quality. Little of it is now mature. Many stands approaching maturity are understocked or are stocked with trees of the less desirable species; whereas in the young stands, which form nearly half the forest area, the trees are often so crowded that rapid and profitable development is impossible. The forest contributes little to the economy of the watershed, although it could be important in this respect. A small amount of saw timber is harvested but inferior resources restrict development of this industry. The same is true of pulpwood, although small amounts are cut and shipped by truck to mills at the

Dairying is the backbone of agriculture on the watershed and many good herds are to be seen.



Root crops are stored for winter use on many farms.



Oats is the chief grain grown.



at the Lakehead cities. Cordwood cut for fuel appears to be the most important present use.

Three main types account for practically all of the forest cover on the watershed. The swampy areas contain black spruce and tamarack. Small areas of lighter soil near Rosslyn Village support jack pine stands. On the remaining, somewhat heavier upland soils, the forest cover is almost entirely poplar and white birch with a small mixture of balsam fir or spruce.

On the cleared land hay occupies the greatest acreage of any single crop. Most of it is cultivated but there is also a considerable acreage of wild hay. The substantial hay acreage is necessary because of the rather long period during which the cattle must be barn fed. A much smaller acreage of the cleared land is devoted to pasture but it should be noted that much of the woodland is used for this purpose.

The grain crop consists mainly of oats but a small acreage of mixed grain is also grown. Potatoes and turnips are the chief hoe crops although in neither case are the acreages large. Near Fort William market garden crops are grown on small holdings - chiefly vegetables but with some small fruits. Flowers and plants for the trade and home gardens are also produced, both in the greenhouse and in the open.

Other developments have also taken place to satisfy market needs. Some of these use a fairly large amount of land while others use rather little. Roads, railways and the airport use considerable acreages. A small muck deposit on John Street is being exploited and the screened product is sold in the cities as a top-dressing for lawns. On the edge of the watershed at Rosslyn Village the lacustrine clays laid down in Lake Algonquin are being used in the manufacture of bricks. These clays have been worked for quite a number of years.



There are many acres of potentially arable land but it must be cleared of bush and often of stones before it is satisfactory for cultivation.



Special land uses include the excavation and screening of muck soil for sale.



Many areas in the watershed are posted.

The valley contains and is surrounded by a disturbed wilderness but there appears to be less of it available for public use near the cities than one might think. From observation it would seem that the woodlands are at least as heavily posted against hunting and general recreation as any private lands in Southern Ontario. The streams are small and do not appear to be important in sport fishery at the present time.

A very minor amount of land is presently being cleared for cultivation. The area thus gained for agriculture seems more than offset as formerly cleared lands return to scrub. Some of this land should never have been cleared but the balance is quite capable of paying its way in agriculture.

CHAPTER 3
CAPABILITY OF THE LAND

1. Introduction

Resources may be classified into two broad groups - those which are renewable and those which are not.

The non-renewable resources include those such as oil and minerals which once used cannot be replaced, at least with our present level of knowledge. We can extend the life of deposits of these materials often by using substitutes, by rationing, or by other means.

Our renewable resources can be despoiled but cannot be destroyed. We may render our soils, waters, forests and wildlife unfit for use in our time, and for generations to come, but eventually nature will heal the wound. Wildlife is, perhaps, a notable exception to this in that it is possible for man to destroy a species. The complete extinction of the passenger pigeon is a recent example.

Although nature will eventually rectify the damage it is little consolation to ourselves and our heirs; we cannot live that long and must consequently take steps to see that we leave our land in at least as good condition as we got it. To do this we must understand as well as we can the nature of the resource we are using. In the case of land even the casual observer is well aware that it is not uniform - there are hills and hollows and sands and clays. Also, not every piece of land is suited to, or capable of, the same use.

A determination of the use for which a piece of land is best suited may be accomplished on a trial-and-error basis. Often the results are good, often they are not. A Conservation Authority, engaged in the improvement of its watershed, cannot, as a public body, do things on such a basis. To do a satisfactory job it must, most of the time, proceed according to a plan and have an end in view. Unless there is good reason it should not, for instance, reforest those areas

which are best suited to agriculture as a long-term use. Likewise, it should not acquire for an Authority Forest those lands now in forest which offer promise to agriculture. The same holds true in other fields.

In order that the Neebing Authority may carry out its job of watershed improvement more effectively the Conservation Branch of the Department of Planning and Development made a survey of the land conditions and resources of the valley. An assessment of the capability of the land was made, based chiefly on physical factors, and a map drawn showing the watershed in these terms. Development of the watershed according to this broad plan is desirable and will prove beneficial in reducing erosion and raising the productivity of the land.

Land capability means the suitability of a piece of land for a specified use. The capability of the land may be measured in terms of cultivation agriculture, grazing, urban use, industrial use and so on. In no two cases will the yardstick used necessarily be the same. A piece of land may be first class for industrial use, for example, and much less valuable for agriculture. In the case of the Neebing Valley the land was considered from the point of view of its suitability for general farming.

In assessing the capability of the land, attention was paid to the soil types, erosion, slopes, present land use, climate, drainage and bedrock. The opinion and experience of farmers and others was also considered. The existence of woodland was not taken into account although this factor would, of course, be important in the mechanics of clearing and breaking land for agricultural use and in the cost of so doing.

2. The Land Classification

The suitability of land for agricultural use may be rated in four main categories:

- A - Suitable for cultivation
- B - Suitable only for occasional cultivation
- C - Suitable only for permanent vegetation
- D - Not suited to commercial cultivation, grazing or forestry.

The land of the Neebing Valley was rated according to these categories, but it should be noted that the ratings are relative to the land in the area. In other words, land rated as Class I in the valley is not necessarily the equal in capability to Class I land in south-western Ontario where a different climate prevails. It can, however, be used similarly and can produce well the crops common in the area.

The broad classes outlined above may be further subdivided:

A - Suitable for Cultivation

- | | |
|-----------|--|
| Class I | Without any special restrictions over and above good farming. Is level, well drained, moderately productive, only slightly subject to erosion regardless of use. |
| Class II | With moderate restrictions in use and simple, more specialized conservation practices. Is rolling, or level but less fertile than Class I; may be stonier, imperfectly drained, more susceptible to erosion. |
| Class III | With severe restrictions in use and intensive conservation practices. Similar to Class II but conditions more severe. |

B - Suitable Only for Occasional Cultivation

- | | |
|----------|--|
| Class IV | Best used for permanent vegetation but may be cultivated occasionally. May be difficult to drain or too rough or steep for tractor work. |
|----------|--|

C - Suitable Only for Permanent Vegetation

- | | |
|-----------|--|
| Class V | With no special practices or restrictions. Fairly level land, but too wet or bouldery. |
| Class VI | With some restrictions in use or special practices. Very rough or steep land - may be bouldery or wet in places. |
| Class VII | With severe restrictions in use or special practices. Like Class VI but conditions more severe. |

D - Not Suited to Cultivation, Grazing or Forestry

- | | |
|------------|--|
| Class VIII | Includes areas of rock outcrop and marsh |
|------------|--|

NEEBING RIVER WATERSHED

RECOMMENDED LAND USE
ACCORDING TO USE CAPABILITY
INCLUDING RECOMMENDED AUTHORITY FOREST

USE CAPABILITY CLASSES

SUITABLE FOR CULTIVATION

- I WITH NO SPECIAL PRACTICES
- II WITH SIMPLE PRACTICES
- III WITH INTENSIVE PRACTICES

SUITABLE FOR LIMITED CULTIVATION

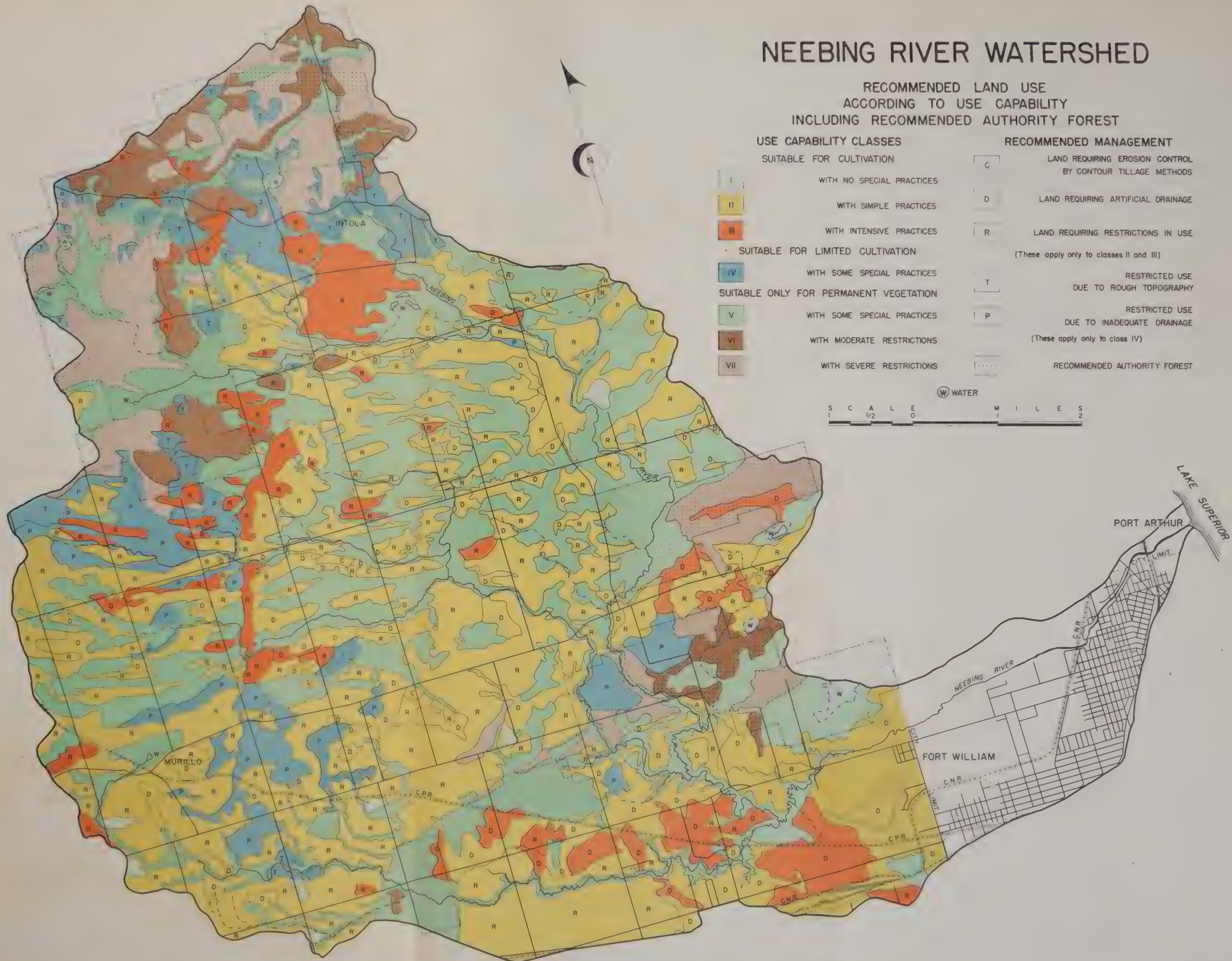
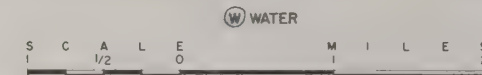
- IV WITH SOME SPECIAL PRACTICES

SUITABLE ONLY FOR PERMANENT VEGETATION

- V WITH SOME SPECIAL PRACTICES
- VI WITH MODERATE RESTRICTIONS
- VII WITH SEVERE RESTRICTIONS

RECOMMENDED MANAGEMENT

- C LAND REQUIRING EROSION CONTROL BY CONTOUR TILLAGE METHODS
- D LAND REQUIRING ARTIFICIAL DRAINAGE
- R LAND REQUIRING RESTRICTIONS IN USE
(These apply only to classes II and III)
- T RESTRICTED USE DUE TO ROUGH TOPOGRAPHY
- P RESTRICTED USE DUE TO INADEQUATE DRAINAGE
(These apply only to class IV)
- Recommended Authority Forest (indicated by a dashed line on the map)



To facilitate appreciation of the various land classes certain suffixes have been added to the class symbol with a view to describing more accurately the land condition. For instance, those lands which suffer an impediment because of restricted drainage take the suffix D (as II D), and those which are too irregular or too rough for contour cultivation take the suffix R (as II R). Those to which contour cultivation methods may be applied are denoted by the symbol C (as II C). Classes V, VI, VII and VIII should not be cultivated and carry no additional designation.

3. The Land Classes on the Watershed

Land Class I

Class I land is suitable for any use which the local climate permits. It is well drained, level and easily worked. The type comprises only 0.3 per cent of the watershed, less than 200 acres, of which two-thirds is already cultivated.

Land Class II C

This land is characterized by long smooth slopes which would be suitable for contour cultivation methods. It is moderately fertile but subject to erosion. Only 70 acres of land were mapped in this class.

Land Class II R

This class occupies the largest acreage of land of any class in the watershed - over 15,000 acres. This land type has slopes of not more than 7 per cent and is level to rolling with good drainage. There is a variety of soils - loams, silts, clays, and sands. The sands have an inherently lower fertility, but are usually deep and easily worked.

Under normal circumstances the Algonquin sands of the Neebing plain west of Fort William would be considered poorly suited to agricultural use because of low fertility and excessive drainage. In view of the expansion westward by the city and the present and probable future alienation of this

land to small holdings and other uses, it may be regarded as possessing a higher capability. Under small holding operations these lands can be made quite productive for small fruits, vegetables and, perhaps, flowers.

The nature of the land is such as to restrict the application of contour cultivation methods. Three- or four-year rotations and winter cover crops would be useful in maintaining fertility and reducing erosion.

Over 40 per cent of this land class is forested and only 30 per cent cultivated. The balance is in poor pasture, wild hay, idle and so on. Expansion of agriculture in the watershed will take place chiefly on this class of land.

Land Class II D

Drainage is the major limiting factor on this land, much of which is found in the south-eastern part of the watershed where sands are underlain by clay which impedes drainage. Adequate drainage outlets are easily secured.

Most of the city of Fort William is built on this type of land which is about 37 per cent in urban use, 30 per cent in forest and scrub, and only 15 per cent cultivated. A great deal of the expansion of the city is taking place on this land.

Land Class III C - None mapped on the watershed.

Land Class III R

Land Class III R differs from II R chiefly in degree. It is more hummocky and more steeply sloping. It includes small areas of excessively drained sands or stonier soils. Like II R land it may include small low-lying areas where restricted drainage is a problem, and also small areas where the bedrock reaches the surface.

Most of this class is found in the rock knob uplands and about one-half of it is forested. Two-thirds of the 30 per cent cultivated is in hay.

Land Class III D

Poorly drained sands in the southern part of the watershed comprise the bulk of this type. Cultivation would be easy but drainage is difficult and fertility low. About 77 per cent of the type is covered by forest and scrub.

Land Class IV D

This class is almost completely covered by forest and scrub. The difficulty involved in draining renders it unsuitable for continuous cultivation. The high cost of development and the uncertain return suggest that the present forest should be preserved and improved.

Land Class IV T

Most of this type is found in the rock knob upland and is characterized by roughness, steep slopes, stony soils and some rock outcrops. It is best used for hay and pasture but some grain crops may be taken.

Land Class V

This type is well distributed through the watershed and nearly all of it is in forest or scrub. It comprises the river bottomlands and the muck areas. Both are wet and subject to flooding. The forest cover should be retained and improved.

Land Class VI

Land Class VI as found in the rock knob uplands is characterized by slopes of over 15 per cent and by frequent rock outcrops. Another area of this class is found in southern Oliver and McIntyre Townships where shallow sands overlies slate bedrock. About 97 per cent of the type is in forest and scrub and it would be well if it stayed that way. The forest should, of course, be improved and managed.

Land Class VII

This type is nearly all in forest and includes steeply sloping land with thin soils. Rock outcrops are numerous.

Spruce is in great demand. Proper management will retain good stands on the swampy areas.



This jack pine stand on the sand plain needs thinning to promote faster growth to quality products.



Land Class VIII

Because the individual areas of this type were too small to map separately they were included in Class VII.

On the unimproved lands considered potentially suitable for agriculture (land classes I, II & III) the forest cover will offer developmental problems. Clearing of this cover will take time and will involve a considerable expenditure of funds. Once cleared and in a satisfactory condition for cultivation the chief problem will be the maintenance and improvement of soil fertility. This will involve the use of satisfactory land practices, including the application of fertilizer in desirable amounts and of the correct rating for the soil and crop in question. Advice regarding soil testing may be obtained by farmers from the Agricultural Representative at Port Arthur. Most of the poorly drained peat and muck land is considered unsuitable for agriculture because of the developmental difficulties and high costs involved.

4. Forest Land Capability

On most of the land designated as suitable for permanent vegetation the present poor quality of forest stands is not inherent. There are some areas with soils too thin, too rocky or too wet to support anything but low quality scattered stands. Much of the understocked area, however, is capable of growing fully stocked stands. In addition, much of the area covered with hardwoods which are in low demand is equally capable of growing spruce or jack pine, for which demand is very heavy.

TABLE VII
NEEBING VALLEY LAND CLASSES

Land Class	Acres	Per Cent
I	192	.3
IIR	15,480	27.7
IID	9,772	17.5
IIC	70	.1
IIIR	2,278	4.1
IIID	1,712	3.1
IIIC	-	-
IVT	1,674	3.0
IVP	2,518	4.5
V	15,378	27.5
VI	2,156	3.9
VII	4,448	8.0
Water	160	.3
Total	55,838	100.0

CHAPTER 4

A RECOMMENDED CONSERVATION PROGRAM

1. The Authority and Conservation Education

Many agencies at present do, or can, engage in conservation education. The Authority can supply opportunities and materials to encourage and enlarge these activities. Wall maps, literature, conservation pictures and conservation lectures supplied to the schools will help to give school courses in geography, history and conservation a local significance. Building up a library of slides on local conservation problems and accomplishments would be of great assistance to speakers. Organization of public meetings and contact with individuals and groups such as farm forums will gain support for both private and public conservation efforts. Landowners should be encouraged to make greater use of the services available from the Conservation Authority and from officers of the Department of Lands and Forests and the Department of Agriculture.

The most effective educational activity is actual participation in or field observation of conservation projects. Tree planting days, land judging competitions, group visits to woodlot improvement or erosion control projects and conducted tours over a well organized conservation trail could all be sponsored by the Conservation Authority. These activities would all stimulate individual action on conservation measures such as those described in the following sections.

" There is the need of an educational programme to develop the art and philosophy of true husbandry. If we would stabilize our northern settlements, husbandry must replace exploitation in the minds of the farmer, the forester, the wildlife manager and the all-crop husbandman. Combination or multiple-use husbandry of a satisfactory type must be developed."*

* Hills, G.A. - The Role of Forestry in the Conservation of Settlement Lands in Ontario. Soil Research Brief No. 5, Ontario Dept. of Lands & Forests, 1949.

2. Forest Conservation

Conditions on the Neebing Watershed are well adapted to a farm-forest economy, whereby the land holder does not rely on either agriculture or forestry alone for his income but combines the two and uses all his land, each part according to its capability. Fortunately much of the work needed to improve the forest can be fitted into the slacker periods in agricultural operations, and even the rural resident who works in the city will find a little properly directed spare time work on his woodlot well worthwhile.

With the local population and the forest industries of the Lakehead cities so close at hand, it is not surprising that depletion of the original mature timber stands of the Neebing Watershed has been much more rapid than the average for the Port Arthur District as a whole. It is, however, this very proximity to established markets which enhances the value of any future production from the forests of the watershed. Since such a large proportion of the watershed is not only in forest at present but is best suited for permanent use as forest land, the improvement or neglect of the forest must have a marked effect on the economy of the area.

The measures needed to improve the woodlands of the Neebing are suggested by the description already given; mature or nearly mature stands understocked, many young stands overcrowded, and a marked preponderance of hardwoods. For the Port Arthur District as a whole the 1953 report of the Forest Resources Inventory indicates that only 4 per cent of the current hardwood growth is finding a market, while utilization of spruce equals the total growth available.

On the Neebing, the few remaining areas of well stocked forest where conifers predominate may be perpetuated by careful cutting of the present stands. Careless cutting will certainly result in their deterioration. In the mixed

Too much of the forest area of the Neebing is occupied by scrubby poplar.



Thinning of young stands prevents growth stagnation and reduces the time needed to grow merchantable products.

stands cutting should be planned to reduce the percentage of hardwood and favour the conifers, particularly by releasing young conifers from suppression and promoting more rapid growth. Sometimes in such stands, if utilization of the hardwoods is impossible, it may be advisable to kill the hardwoods by girdling or spraying in order to release the conifers.

Tree planting on the Neebing will be of importance but will not involve the reforestation of large open areas since little of such land occurs on the watershed. Planting is needed to fill up small gaps and increase the stocking of understocked stands, and underplanting is needed to increase the percentage of conifers where they are lacking or only sparsely represented.

In densely stocked young hardwood stands growth of each tree is slow and trees are prevented from reaching merchantable size in a reasonable time. Cutting for fuel or other purposes should be planned to relieve this overcrowding and favour the best stems. Here again girdling may be advisable. This will hasten the time when the remaining stems become merchantable and when underplanting can be done successfully where desirable.

3. Authority Aid to Private Forestry

Bringing to the attention of those concerned the needs and methods of better woodland management should be a primary aim of the Neebing Valley Conservation Authority. While experimentation is desirable to determine the best method of handling certain problems, the general principles of woodlot management have been known for years but have not been applied. A free advisory service is available from the Zone Forester at Port Arthur, but is not sufficiently used, and a readily understood pamphlet on "The Farm Woodlot" can be obtained from the Department of Lands and Forests. The Authority Forest, (discussed in the following section) would provide excellent facilities for field demonstrations of recommended methods.

Most of the tree planting required on the Neebing would have to be done by hand. Under such conditions some Authorities offer a direct subsidy of \$10.00 per thousand trees after planting, if inspection shows that the work has been done carefully and the plantation is secured from damage by livestock.

In 1908 the first provincial forest nursery in Ontario was established at St. Williams in Norfolk County. Subsequently other nurseries were established at Midhurst, Orono and Kemptville. By 1946 the need was recognized for planting stock produced in Northern Ontario to plant cut-over or burnt-over lands where natural regeneration has not succeeded. As a result the Thunder Bay Forest Nursery was established in that year on a 400-acre tract in Paipooonge Township where water from the West Branch of the Neebing River is available for irrigation. By 1956 annual production had risen from 250,000 trees to 2,000,000 trees and further steady increases in production are planned. The main species produced are black spruce, white spruce, jack pine, red pine and white pine. About one-quarter of the trees are distributed to private landowners and the remainder used for planting on Crown land, including lands leased to pulp and paper or lumber companies.

It is the policy of the Department of Lands and Forests to charge \$14 per thousand for Scotch pine and \$10 per thousand for other planting stock. For some years trees were distributed free. Following the end of the war in 1945, the nurseries were unable to meet the greatly increased demand, and it was felt that a charge for trees would ensure more care in ordering the required amount and in planting the trees received.

The assistance schemes carried out by other Authorities have stimulated interest in private reforestation while still ensuring the good use of the planting stock. It

is recommended that the Neebing Valley Conservation Authority adopt some similar policy of assistance to private reforestation.

In the past few years a movement has been under way to recognize well-managed forest properties as Certified Tree Farms. With the sponsorship of several organizations interested in better forestry, the Canadian Forestry Association in 1953 formed a National Tree Farm Committee to recognize with a suitable sign and certificate those owners who agree to maintain their land for growing forest crops, protect the land adequately, agree that cutting practices will be satisfactory to ensure future forest crops, and permit inspection by Committee foresters. One such farm has already been certified on the Neebing Watershed. Several Conservation Authorities have become co-sponsors of the Tree Farm movement in their areas, and it is recommended that the Neebing Valley Conservation Authority give its support to this movement.

4. Neebing Authority Forest

Where large areas exist with little or no land in them really suitable for agriculture, acquisition by the Authority is recommended. This is particularly desirable where these forests form natural water-storage areas which decrease the severity of floods and maintain the summer flow of streams. Under proper management these lands can again be brought into a condition where they will add materially to the economy of the area.

In all 11,410 acres in five blocks are recommended for acquisition by the Neebing Valley Conservation Authority. These blocks may be described briefly as follows:

(a) Dawson Block - This large block, 6,970 acres, comprises the swamps and rock knob uplands north and west of Intola. Only 524 acres are in cleared fields, and these in general are used only for pasture or have fallen into disuse. Lakes and bog cover 42 acres and scrub willow and

alder another 164 acres. The remainder, except for the rock outcrops, is covered with woodland, most of which is producing at a rate far below its capacity.

(b) John St. Block - This 1,437-acre block, between John St. and the Oliver Road, contains practically no cleared land. It consists of glacial till and outwash soils over flat bedrock which occasionally outcrops on the surface.

(c) Oliver Block - South of the Oliver Road is an area of 2,206 acres of which 125 acres have been cleared, 216 acres are small lakes and bog and 60 acres are covered with scrub growth. Algonquin sediments and muck cover most of the area

(d) Arthur Block - This block of 450 acres in Paipoonge Township is entirely covered with woodland and scrub. The soils are muck and very shallow sediments over flat bedrock. Most of the woodland is coniferous swamp.

(e) Rosslyn Block - North of Rosslyn Village is a 347-acre tract similar to the previous block but with deeper soils.

The classification of these blocks is summarized in the table below.

TABLE VIII
RECOMMENDED AUTHORITY FOREST - LAND CLASSIFICATION

Block	Cleared Land Acres	Lakes & Bog Acres	Scrub- land Acres	Wood- land Acres	Total Acres
1. Dawson	524	42	164	6,240	6,970
2. John St.	4	-	118	1,315	1,437
3. Oliver	125	216	60	1,805	2,206
4. Arthur	-	-	112	338	450
5. Rosslyn	-	-	85	262	347
Total	653	258	539	9,960	11,410
Per Cent	5.7	2.3	4.7	87.3	100

The agreements for establishment and management of Authority Forests, which have been drawn up between the Ontario Government and twelve of the Conservation Authorities, run for a period of 50 years and provide for the Government to establish the forest and pay the cost of such items as fencing, buildings, equipment, labour, maintenance, planting stock, etc. - in short, everything connected with the management of the forest. In addition, the Government will advance half the cost of the land as an interest-free loan for the period of management.

At the end of the 50-year period the Authority may exercise any one of three options: first, to take the forest over from the Government and pay back the cost of establishment and maintenance without interest; second, to relinquish all claim to the forest, whereupon the Government will pay to the Authority the balance of the land cost without interest; third, the forest may be carried on as a joint undertaking by the Province and the Authority, each sharing half of the cost and half of the profits. Authority lands are subject to municipal taxes. The form of an Authority Forest Agreement is given on the following pages.

While detailed scientific research is the task of universities or government departments with greater research facilities than are available to a Conservation Authority, there are many possibilities for small-scale investigations which are urgently needed and which might be undertaken to advantage on the Authority Forest. Determination of the best planting methods under local conditions, comparison of growth in different plantation mixtures or under local conditions, comparison of growth in different plantation mixtures or under different degrees of thinning or other treatments are all projects which would guide the people of the watershed in managing their own woodlands. The Authority should encourage such investigations and co-operate with the Department of Lands and Forests in carrying them out.

AGREEMENT made this day of 19 ,

B E T W E E N

THE HONOURABLE CLARE E. MAPLEDORAM,
Minister of Lands and Forests for the
Province of Ontario, hereinafter re-
ferred to as the "Minister",

OF THE FIRST PART:

-and-

CONSERVATION
AUTHORITY, hereinafter referred to as
the "Authority",

OF THE SECOND PART:

THIS AGREEMENT WITNESSETH that in consideration of
the mutual agreements and undertakings herein the Parties
hereto covenant and agree with each other as follows:

1. The Authority doth hereby demise and lease unto the
Minister the lands described in Schedule "A" hereto for the
term of 50 years from the date hereof for reforestation and
management.
2. The lands described in Schedule "A" hereto are herein-
after referred to as the "Forest Area".
3. The Minister shall reforest and manage the Forest
Area, and shall furnish free of charge to the Authority nursery
stock that is in his opinion best suited to the reforestation
of the Forest Area.
4. The Minister shall furnish the equipment and shall
erect and maintain the fences, structures, buildings and
improvements that are in his opinion required in connection
with the reforestation and management of the Forest Area, and
the cost thereof shall be borne by Her Majesty the Queen in
right of Ontario.
5. Where the Authority, with the approval of the
Minister in writing, acquires any land for the purposes of
this agreement, Her Majesty the Queen in right of Ontario shall
advance by way of a loan at the time of any such acquisition

one-half of the purchase price paid by the Authority for any such land, and the Authority shall not sell or otherwise deal with any such land until it has first obtained the consent of the Minister in writing.

6. Her Majesty the Queen in right of Ontario shall be entitled during the term of this agreement or any renewal thereof to the profits of the Forest Area derived from the sale or other disposition of the timber, structures, buildings, or improvements thereon.

7. Upon the termination of this agreement the Minister may renew this agreement for a further term of fifty years upon such terms and conditions as he deems proper, subject, however, to the right of the Authority to give notice in writing to the Minister at least one year before the expiry date of this agreement, and to pay to the Treasurer of Ontario the portion of the purchase price of the lands in the Forest Area advanced by way of a loan by Her Majesty the Queen in right of Ontario to the Authority under this agreement and the amount of the costs incurred during the term of this agreement by Her Majesty the Queen in right of Ontario in connection with the management and reforestation of the lands in the Forest Area, including the costs incurred in the erection and maintenance of fences, structures, buildings and improvements, after deducting therefrom the amounts of the profits of the Forest Area derived from the sale or other disposition of the timber, structures, buildings or improvements thereon, whereupon the Authority shall hold the lands in the Forest Area freed of all claims of Her Majesty the Queen in right of Ontario, Her successors and assigns.

8. In the event that this agreement is not renewed and the Authority does not exercise its right under paragraph 7, the Authority shall grant the lands in the Forest Area to Her Majesty the Queen in right of Ontario as represented by the Minister of Lands and Forests in fee simple, free from all

encumbrances, and shall execute a conveyance of the said lands upon payment by Her Majesty the Queen in right of Ontario to the Authority of the purchase price paid by the Authority for the said lands, after deducting therefrom the portion of the said purchase price advanced by way of a loan by Her Majesty the Queen in right of Ontario to the Authority under this agreement.

9. This agreement or any renewal thereof shall be registered in the proper registry or land titles office in accordance with The Forestry Act, 1952.

10. In case of disagreement as to the true intent and meaning of this agreement, the same shall be referred to arbitration under The Arbitration Act.

IN WITNESS WHEREOF the Minister has hereunto set his hand and the seal of the Department of Lands and Forests, and the said Authority has hereunto set its seal, attested by the Chairman and Secretary of the said Authority.

SIGNED, SEALED AND DELIVERED
in the presence of

5. Agricultural Development

(a) Pasture Improvement

Agriculture at the Lakehead and in the Neebing Valley has developed primarily around the dairy industry and the supplying of fluid milk to the Twin Cities. This development has resulted in an emphasis on hay and pasture production much of which is unimproved. Experiments at the Fort William District Experimental Substation clearly show that good management combined with good seed and the use of adequate amounts of fertilizer can substantially increase the yield of these crops.

The Neebing Authority might consider embarking, in a small way, on a program devoted to the improvement of pastures in the watershed. This program would involve the demonstration of suitable measures together with checks. The demonstration might be done on Authority-owned land purchased for the purpose, or it might be carried out on a field belonging to an individual who was willing to co-operate with the assistance of the Authority. Complete records of measures used, costs and results should be kept. On site publicity should take the form of a sign on which the measures taken and results obtained could be tabulated.

An enterprise of this kind should be carried out with the full co-operation and assistance of local provincial and dominion agricultural authorities and farmers groups. Once started the demonstration might be left almost completely in their hands.

The location of such a demonstration will involve some thought but it is suggested that an easily accessible, preferably roadside, location in the vicinity of John Street or the Oliver Road would be suitable.

(b) Urban Expansion

Because of the present and probable future expansion of the lakehead cities it seems unlikely that the

Authority will be able to embark on any program of substance insofar as the land immediately west of Fort William is concerned. The expansion of urban uses along the Trans-Canada Highway and along the road to Rosslyn Village is effectively removing this land from agriculture, although horticulture on small holdings is important.

Urban expansion is also taking place westward from Port Arthur but this, as it affects agriculture, is not serious because most of the land involved is not attractive for agriculture in any case.

(c) Gully Control

Gully erosion along the lower portion of the Neebing River is a significant problem and a considerable number of gullies have developed. Once started gullies are nearly always difficult to control and they can soon remove land from most forms of use as well as filling the main stream with sediment. A number of the gullies in this area are undergoing natural revegetation but most appear to be actively eroding in their upper reaches. It is suggested that the Authority, through publicity and through more direct aid where it is able, promote those forms of land use which reduce the possibility of gullies developing and treat those which have developed.

(d) Expansion of Cleared Land

The survey has shown that a significant acreage of potentially arable land, not now being so used, exists on the watershed. As the population of the area increases and the demand for agricultural products likewise, it is probable that some of this land may be cleared and broken. The Authority should try to see that such development takes place in an orderly fashion and does not have a detrimental effect on other Authority projects. In this regard it might be well to note that the Department of Agriculture of the Province of Ontario instituted an assistance policy

in 1946 with a view to aiding bona-fide farmers and settlers in Northern Ontario. The assistance takes the form of subsidies with conditions and may be obtained for, among other things, land clearing and breaking, drainage and livestock purchase.

(e) Windbreaks and Snow Fences

Although much of the watershed is covered by forest the shelter from wind and sun afforded by trees is lacking around many of the homesites and fields in the agricultural areas. Trees around the homesite have an aesthetic value as well as providing insulation during the warm and cold seasons. In the fields and along roadways rows of trees along the fence lines reduce snowdrift and rows, clumps of trees or single trees provide needed shade for livestock. The question is one with which the Authority might logically concern itself.

When proper species are used and windbreaks are correctly placed the effects are almost entirely beneficial. The effects may be direct or indirect, but in either case are the result of reduction in wind velocity. The effects of windbreaks on crops and cultivated fields may be listed as follows:

(1) Direct effects

- a Wind damage and lodging in small grains and corn is reduced or eliminated.
- b Snow and the resultant moisture are more evenly distributed over fields, particularly on the higher spots where they are required most.
- c Wind erosion of the soil is minimized.

(2) Indirect effects

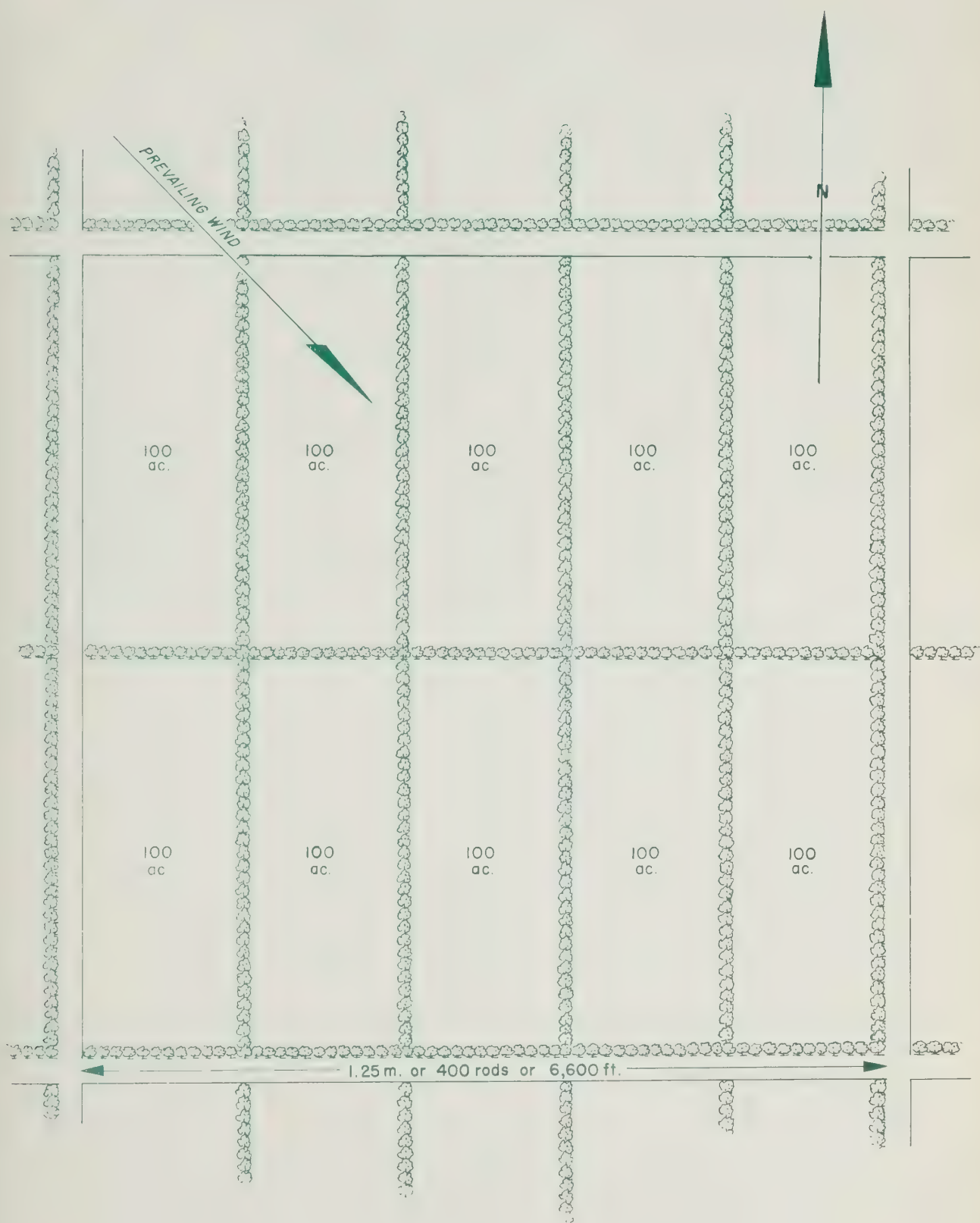
- a Moisture loss by evaporation is reduced.
- b Temperatures in the fields are raised, which may prevent frost damage, accelerate growth and even lengthen the growing season slightly.
- c Erosion of the soil by water may be reduced by its more even distribution when released from snow.

The benefits of windbreaks to buildings in reducing heat loss in winter have been shown to be considerable. Experiments conducted in the United States proved that more than twice as much heat is lost from a house, per day or per hour, with a wind of 20 m.p.h. as with one of 5 m.p.h., and windbreaks can easily reduce wind velocities in this proportion. Used in this way they can often be made to form an effective background for the house and a protection for farm buildings. Another advantage of windbreaks is that they provide shelter and runways for insectivorous birds and small animals.

Belts of trees comprising one or two rows are usually called windbreaks, and with more than two rows, shelterbelts. In Ontario windbreaks as a rule give sufficient protection except where wind erosion of soil on rolling land is severe, when shelterbelts may be required. On level land windbreaks may nearly always be established along existing fence lines, but on rolling land consideration should be given to the contour of the land. The prevailing winds in Ontario are generally from the west, so that the greatest protection will be derived from windbreaks on the west side, but the placement of windbreaks on the other three sides as well should be considered.

Both the height of the trees and the wind velocity influence the effective range of a windbreak. An average windbreak will reduce the ground velocity of a 20-mile wind 10 per cent or more for a distance of about 30 times the height of the trees. About one-fourth of this effect will be felt on the windward side of the windbreak and three-fourths on the leeward side. For example, if the trees are 40 feet high the total effective range with a 20-mile wind will be 30×40 or 1,200 feet, 300 feet of which will be on the windward side and 900 feet on the leeward side. Generally speaking, the reduction in velocity is greatest close to the windbreak and tapers out to zero farther away. With higher

WINDBREAK PLAN
for
1,000 ACRE BLOCK



This plan shows the minimum windbreak requirements for a 1,000 acre block on level land. Woodlots and plantations will replace some of this and placement will have to be adjusted according to topography and soil on rolling land.

wind velocities and/or higher trees the proportionate reduction and the effective range will be greater.

European alder is gaining great popularity as a windbreak tree because it is a nitrogen-fixer like the legumes and does not rob the soil to the same extent as non-nitrogen-fixing species.

One consideration that should be kept in mind is that under certain circumstances windbreaks may cause air stagnation, which may increase temperature and moisture conditions to a dangerous degree in summer or increase frost damage in spring and fall on small areas, particularly in hollows. Where this is likely to occur, windbreaks should be planted so as to guide the flow of air past such spots. Where these conditions develop after the windbreaks are established they may be relieved by judicious opening up of the windbreaks.

Experience has shown that windbreaks are an asset to any farm, that their adverse effects, if any, are local and easily remedied, and that in many areas they are essential to the control of soil erosion by wind. It is therefore recommended that the Authority encourage in every way the establishment of windbreaks by private owners.

The object of a snow fence is to mechanically reduce wind velocity near the ground in such a manner as to cause a drift to form where it will be least harmful. The reduction in velocity creates two pools of relatively calm air, a small one on the windward side and a much larger one on the leeward side, and it is here that drifts form, leaving the area farther to the leeward free of drifts and comparatively free of snow. As winds become stronger the wind reduction and the width of the calm pool on the leeward side will increase and the centre will tend to move farther away from the windbreak.

A wide belt of trees which will accumulate a large drift of snow on its windward side may be planted right

to the edge of the road, the windward edge extending back a distance equal to three or four times the height of the trees and generally at least 100 feet.

In some places the snow trap type of windbreak is effectively used. It is composed of one or more rows of trees close to the road with a wide opening to windward and then a single row of trees. The single row arrests the first force of the wind and the snow is deposited in the opening. This has the advantage of requiring fewer trees than the shelterbelt and leaving the ground between open for cultivation in summer.

Poor placement of windbreaks may accentuate drifting conditions. A single row of trees, unless it is a dense coniferous type, is seldom dense enough to completely stop winter wind, and may likewise create drifts.

Any prejudice which may exist against windbreaks for protection against drifting snow on roads arises from such poor or poorly placed windbreaks. If a windbreak has openings in it or if it ends abruptly streamer drifts will form. Windbreaks should be kept dense and tapered down at the ends by using progressively smaller species of trees and shrubs to prevent the formation of streamer drifts.

Trees are being used successfully as snow fences in Ontario by the Department of Highways, by railways and by a number of counties. Every encouragement should be given to the establishment of such snow fences wherever drifting snow is a problem on the roads of the Neebing Watershed.

6. Farm Ponds

In the past few years farm ponds have become an important part of the landscape in Southern Ontario, particularly in those valleys where established Conservation Authorities have lent aid in their construction.

Aid to farmers in pond construction has taken the form of engineering assistance where this is necessary, financial or both. Where an Authority has offered financial aid it has taken the form of a grant covering a percentage of the cost to a defined maximum. In most cases conditions are attached to ensure that proper construction and maintenance are carried out.

The farmlands of the Neebing Valley contain many suitable sites where low-cost farm ponds could be built. The Authority might consider offering aid in farm pond construction of the kind outlined above.

As mentioned already livestock water requirements in the Neebing Valley are met from well and surface supplies. In a dry year such as 1955 it may be difficult to satisfy these needs because of a lowered water table and drying streams. These conditions have beset many farmers in Southern Ontario and satisfactory relief has often been obtained through the installation of a farm pond. Most often these ponds have been of the simple dug-out kind but permanent stream or spring-fed ponds have also been used. Most of these ponds have been built in those valleys where Conservation Authorities exist and are a reflection of the interest and enthusiasm of the Authorities.

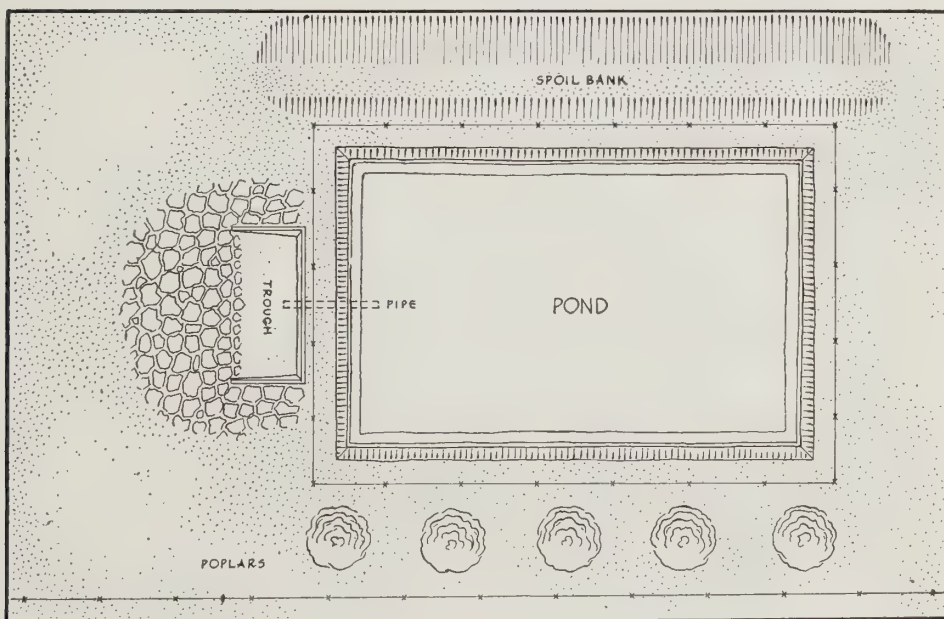
Although the farm pond has been used mainly for stock watering its value is by no means limited to this alone. Depending on the size, location and condition of the pond it may be used for a number of other purposes, including fire protection, recreation and irrigation. The farm pond is also a factor in controlling stream flow and in aiding ground water recharge.

Only one or two farm ponds exist on the Neebing Watershed. There would appear to be room for more and in this regard the Authority might well take a hand in publicizing their value and in providing assistance in their construction.

THE DUG-OUT POND

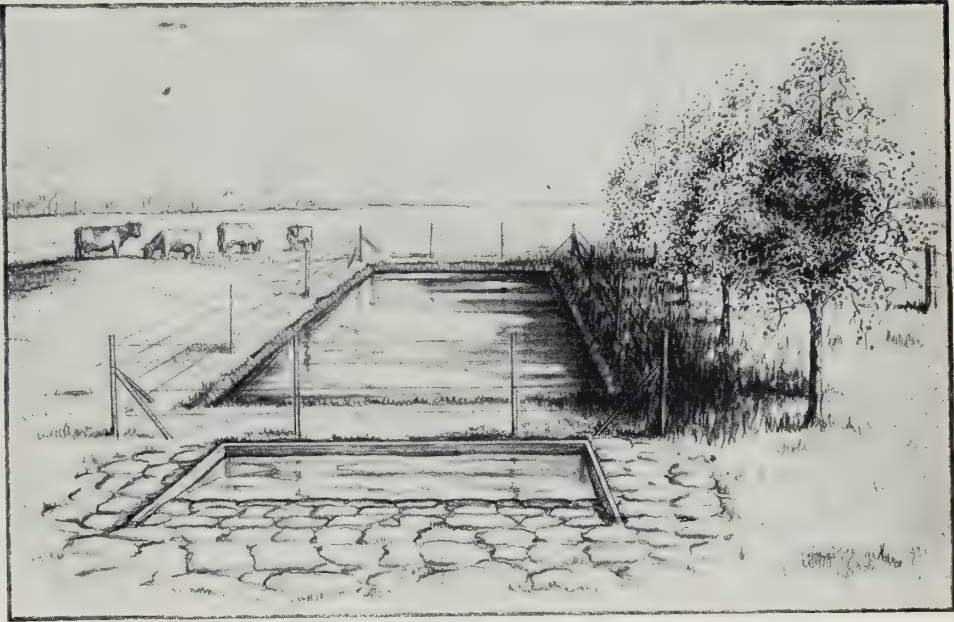


A dug-out, pictured above, is commonly used for watering beef cattle. With no protection such a dug-out is likely to fill with silt and vegetation in a very few years.

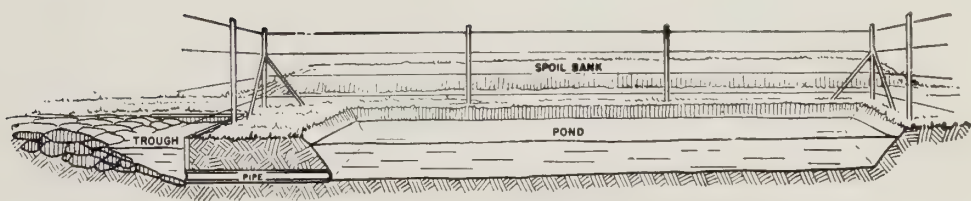


A plan of the sketch shown.

THE DUG-OUT POND



The above sketch indicates how a dug-out pond, should be developed for efficient use. The spoil bank is spread out, the pond is fenced, trees provide shade to minimize evaporation and the water is led by means of a pipe to a trough outside the fence.



A section lengthwise through the dug-out shown indicating how the water is led from the reservoir to a sloping trough paved with large flat stones or coarse gravel.

(a) Types of Ponds

Although the simple dug-out pond would find probably greatest application on the Neebing Watershed, there are several other types which might prove useful or better in specific circumstances. These various pond types and factors in their construction are described below.

(1) The dug-out pond

The dug-out pond is built in a depressional area and receives its water supply from the ground water down to which it is dug. It is the cheapest pond for a farmer to build and is well adapted to pasture land providing the correct site can be found. However, unlike ponds which receive their water supply from springs or creeks, the dug-out pond tends to become stagnant in late summer.

Ground water levels (called the water table) change throughout the year, and late in the summer season may go below the bottom of the dug-out. There is little or nothing which may be done locally to raise the water table, and this type of pond is dependable only in spots known to stay wet all summer.

In certain types of hilly country with irregular slopes and hollows, there are natural waterholes called "kettle" ponds. In many instances these have filled in but can be cleaned out to re-establish ponds. These may sometimes be refilled during the summer by rain running off the slopes around the pond, but this is not common enough to be a dependable source of water.

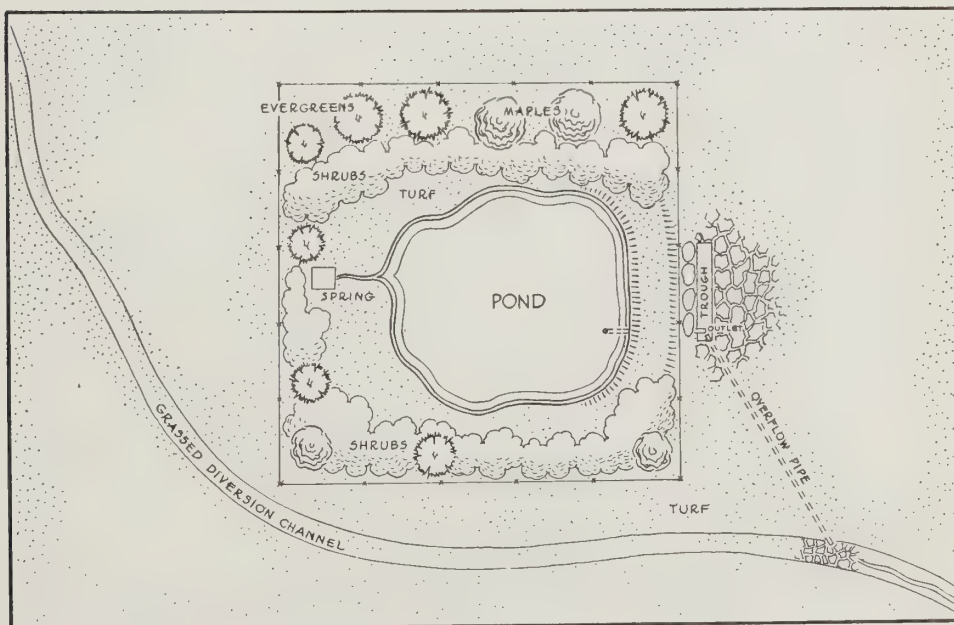
(2) The spring-fed pond

The water supply for this type of pond is derived from a spring, usually up the slope or "draw" from where the pond is situate, and because of its location - that is, in the lower part of a small storage basin - it must be protected from damage and excessive flooding by a grassed waterway or emergency spillway by which the surface run-off is deflected around the pond.

THE SPRING-FED POND



The above photograph is of a spring-fed pond held by a dike with a pipe leading to a watering-trough.

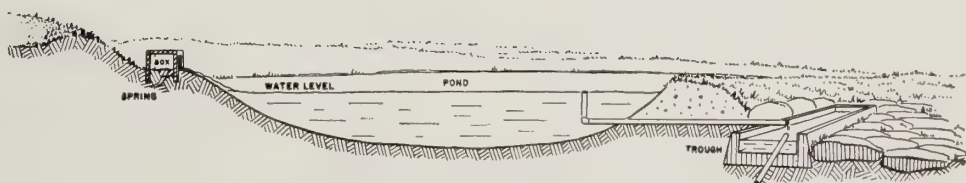


A plan showing the location of the different important features of the pond.

THE SPRING-FED POND



A suggested treatment for improving a pond of the type shown with grassed diversion ditch to carry off surplus water, trees for shade and wildlife, and careful management of overflow, first into a watering-trough and from this to the grassed channel.



A section of the sketch shown from the spring through the watering-trough, indicating the position of the overflow pipe and other features.

Spring water is rainfall which has been stored in the ground and seeps gradually through the soil until it is discharged at a spring. The supply may be that which falls locally on land above the spring, especially if it is light soil; on the other hand some springs get their water from strata of sand and gravel which carry it great distances and the original source may not be known.

(3) The by-pass pond

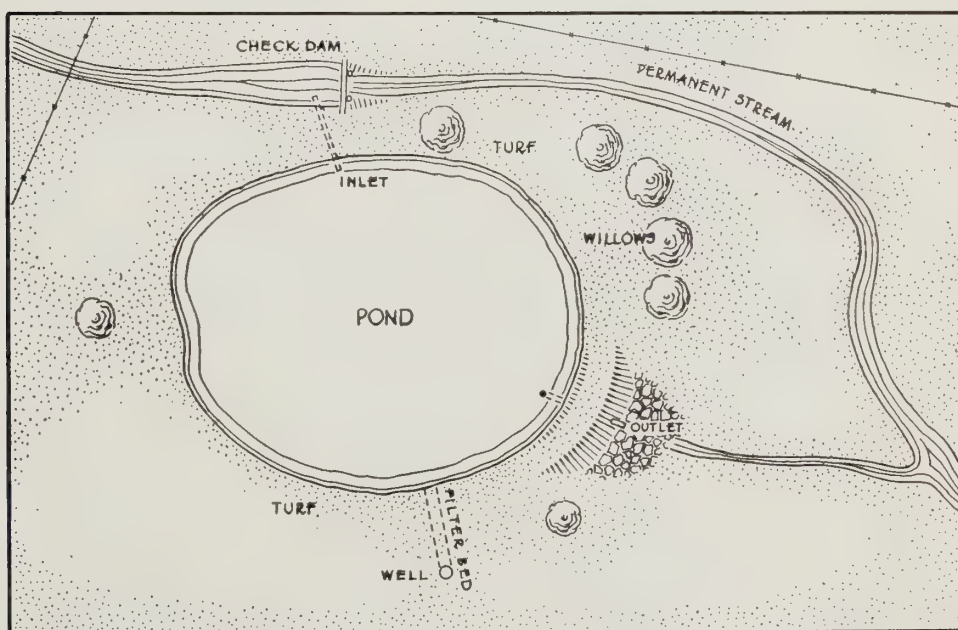
A pond of this class is built close to, but not on, a permanent stream and gets its name from the fact that the water supply is by-passed through a pipe from the stream to the pond. This type has the advantage over some others in that there is no danger of the pond filling up with silt, because any excessive run-off goes down the permanent stream channel and not through the pond. Moreover, the water in the pond can be kept reasonably clean because the supply can be shut off when the stream becomes turbid. This is an inexpensive pond to build and should be attractive to a farmer who has a small permanent creek on his property.

Permanent streams get their water from a number of sources. During the spring thaw or rain, when the soil is saturated, the source is mostly surface run-off or overland flow. Springs are often the first source of streams, especially those that rise in gravelly hills. During drought, stream flow may be maintained by the ground water, the level of which gradually lowers. The ground water may be recharged during autumn and spring. To get as much moisture as possible into the soil and into the ground water, soil conditions and vegetative cover must be favourable. The same practices which help to conserve soil help to conserve water, namely good organic content of soil, contour tillage on long smooth slopes, good sod, and forest cover on steep land and coarse or shallow soils.

THE BY-PASS POND



The above photograph is of a well-managed by-pass pond in Waterloo County. The concrete spillway section and stop logs were in before the pond was adapted to the by-pass type, and are actually unnecessary. The inlet to the pond is beside the tree on the far side.

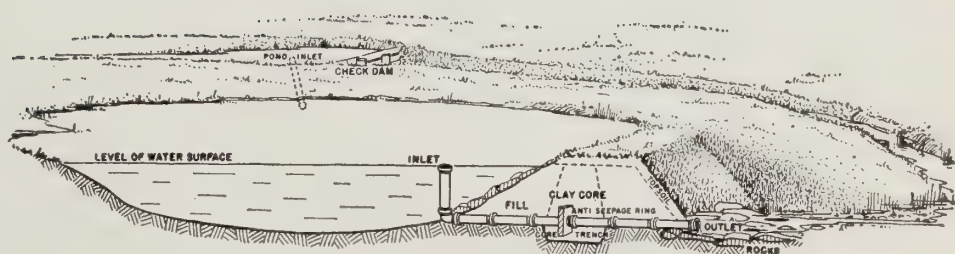


A plan indicating the small removable check dam which diverts water from the stream into the pond, the overflow from the pond to the stream, and also the position of a gravel filter-bed which permits clear water to seep into a shallow well from which the domestic water supply is drawn.

THE BY-PASS POND



A sketch of the same pond with the concrete spillway section omitted and the stream from which the pond gets its water shown more clearly.



A section of the sketch shown with details of earth dam construction and the inlet to the discharge pipe which controls the level of the pond. It should be further noted that the earth dam has a clay core and that the anti-seepage ring is a concrete block which prevents water seeping along the outside surface of the pipe.

(4) The run-off pond

Such a pond gets its name from the fact that the water supply is obtained by the natural percolation and surface run-off which accumulates at the lower elevations of a small drainage basin where the dam is built. The success of such ponds during the summer depends entirely on the amount of rainfall which occurs at that time. The vegetation of the slopes also is an important factor. If the slopes are mostly woodland or permanent pasture or a combination of both, the supply will be more even. If the slopes are cultivated fields, there will be danger from too rapid run-off and silting unless these are cultivated on the contour or strip-cropped.

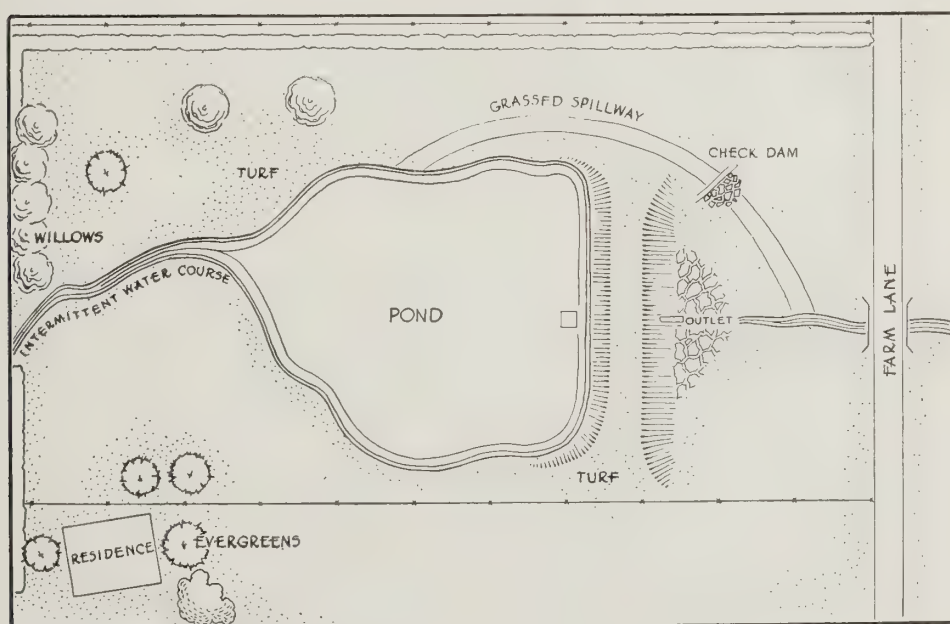
Many run-off ponds can be seen in the Northern United States, where they are very successful. In the State of Ohio, and particularly in the Muskingum region, this type of pond has been developed to advantage. However, in this connection it must be remembered that the annual rainfall in Ohio is usually 40 inches, whereas in the Neebing Valley the average rainfall is close to 24 inches. This extra 16 inches of rainfall in Ohio usually occurs during the summer months. It must also be noted that in Ohio, summer storms with great intensity of rainfall and, consequently, surface run-off are common but they are rare in Ontario. Actually there are many summers in Ontario when there is no surface run-off. A run-off pond near Brantford, in Southern Ontario, is reported to have been recharged by summer rains only once in four years.

While examples of this type of pond can be found in Ontario, and while under favourable conditions such ponds retain water throughout the summer, it is most likely that in years of drought they will dry up. Consequently this report emphasizes the building of other types of ponds recommended herein, until more knowledge is obtained regarding the successful building of run-off ponds.

THE RUN-OFF POND



In this photograph a run-off pond is in process of construction in a farmyard between the house and the farm buildings. It is intended chiefly for fire protection. The pond is supplied by an intermittent watercourse, supplemented by two small springs from a run-off area of approximately 40 acres.

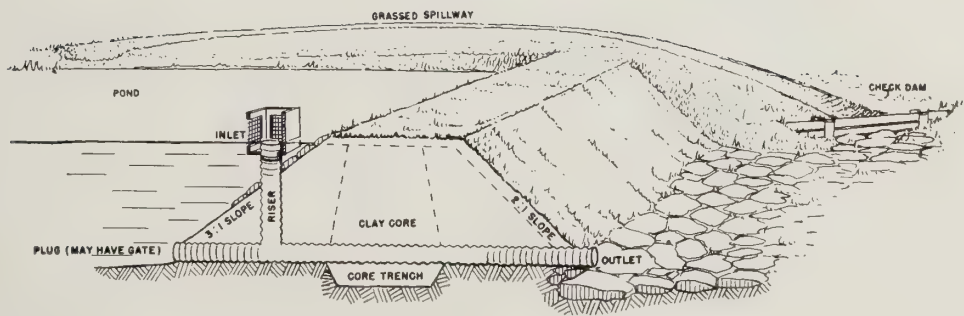


A plan showing the relative positions of the different features included.

THE RUN-OFF POND



A sketch of suggested treatment of this pond, showing the grassed emergency spillway which will carry off heavier than average flows, with a small timber check dam to reduce the gradient of this spillway to a minimum.



A section lengthwise through the pond and dam. The inlet to the discharge pipe is protected by a box with heavy screen to stop trash and ice. The details of construction of the dam should be noted, such as the slopes, the clay core and and core trench, with topsoil and sod on crown and face.

Ponds of the run-off type can only be considered on watersheds greater than 40 or 50 acres on which there is some permanent supply of water, but not on watersheds greater than 150 acres because maximum flows are too great to be handled by earth spillways.

The term run-off is used in measuring the flow in a stream. There are actually two main sources: "surface run-off" or overland flow of water; and "percolation run-off", that is, the water that travels through the soil to reach a stream. Although surface run-off may be very great in extreme instances in the summer, it is not a reliable source of water except during spring thaw or late spring rains.

(5) The permanent stream pond

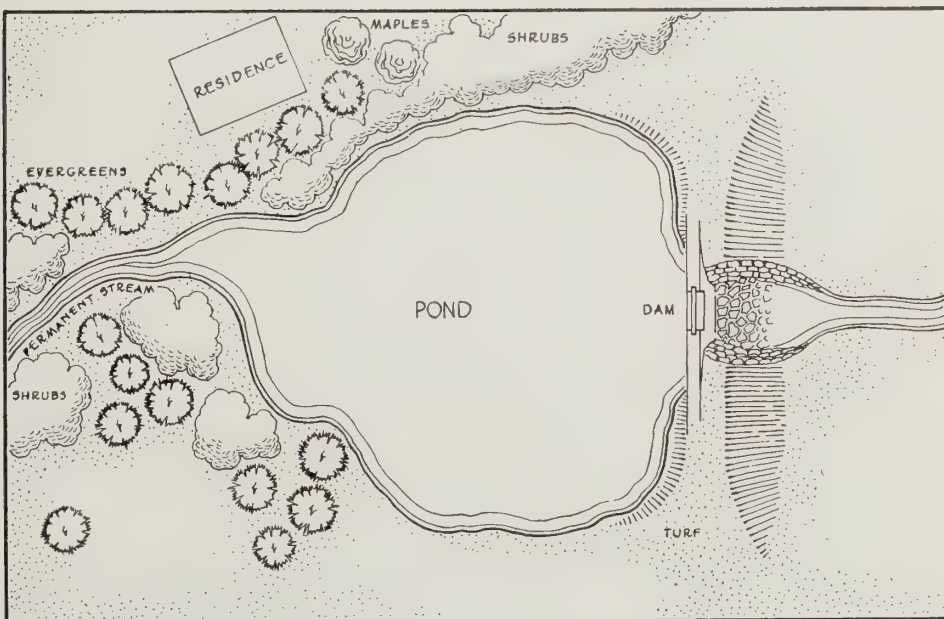
This type of pond is built in the channel of a small permanent stream by erecting a concrete or earth dam or a combination of both across the stream, thus forming a reservoir or pond behind the dam. Such structures require care in planning and if the stream is a large one and the pond is to be of considerable size it will be to the advantage of the owner to secure expert advice, as such structures may run into considerable sums of money. Moreover, under the Statutes of the Province of Ontario it is unlawful to dam a permanent stream without first securing permission from the Surveyor-General, which means that a plan must be filed in his office. The same principles of construction, however, apply to small dams, and where the stream is small the building of such a pond should be within the reach of the average farmer.

Adequate summer flow on permanent streams can hardly be ensured by one property holder, as it depends on the conditions of the whole watershed, which may be thousands of acres. In choosing a site for a dam on a permanent stream, consideration must be given to the conditions over the whole watershed of the stream above that point.

THE PERMANENT STREAM POND



This attractive pond is formed by a small concrete dam (not shown in the picture) crossing a permanent stream which is fed by springs in the distant hills.

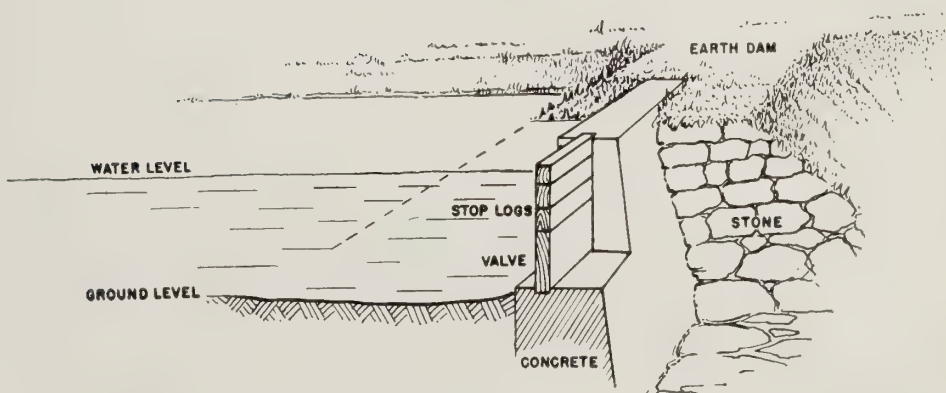


A plan indicating the position of the dam in relation to the other features.

THE PERMANENT STREAM POND



A sketch of the pond indicating the position of the concrete dam. The water level is maintained by stop logs a few inches below the top of the dam, and a simple valve in the lowest log allows water to be drawn from the bottom of the pond.



A section through the concrete structure. It should be noted that the floor of this section of the dam is level with the bottom of the pond. The concrete is set well back into the earth dam and must go deep enough into the stream bed that it will have a firm base and not allow water to leak under it and will not heave with the frost. The stop logs may be removed in anticipation by very heavy flows. If the spillway section with logs removed is as large as the stream channel which feeds the pond, no water should go over the earth structure of the dam.

(6) The temporary pond

The temporary pond is formed by building a temporary dam of wood, or wood and steel, across a permanent stream, which is removed in the fall to allow the spring freshets to come down. Such dams are used on streams which have excessive run-off in the spring but a comparatively small flow in summer. They are a means of building a summer pond where the cost of a permanent dam large enough to withstand the buffeting of spring freshets would be too expensive.

(b) Facts to be Emphasized

While it is difficult to set down in a report of this kind explicit instructions for building all types and sizes of small dams, it would be well to emphasize a few items which are common to all, especially earth structures which find their greatest use on the farm.

(1) The impervious section of core

The type of soil and how it is built into the dam is very important. Some part of the dam must be impervious, or nearly so, to the seepage of water. If the site provides a clay soil or soil with a high percentage of clay this is most satisfactory. If, on the other hand, the soil is sand or gravel, a core of heavier soil must be built in the centre. In big expensive dams this core is sometimes a concrete wall, steel sheet piling or even plank. With the dams described in this report such expensive cores of course are not necessary, although if no clay is obtainable a core of double cedar planks, creosoted, could be used to advantage.

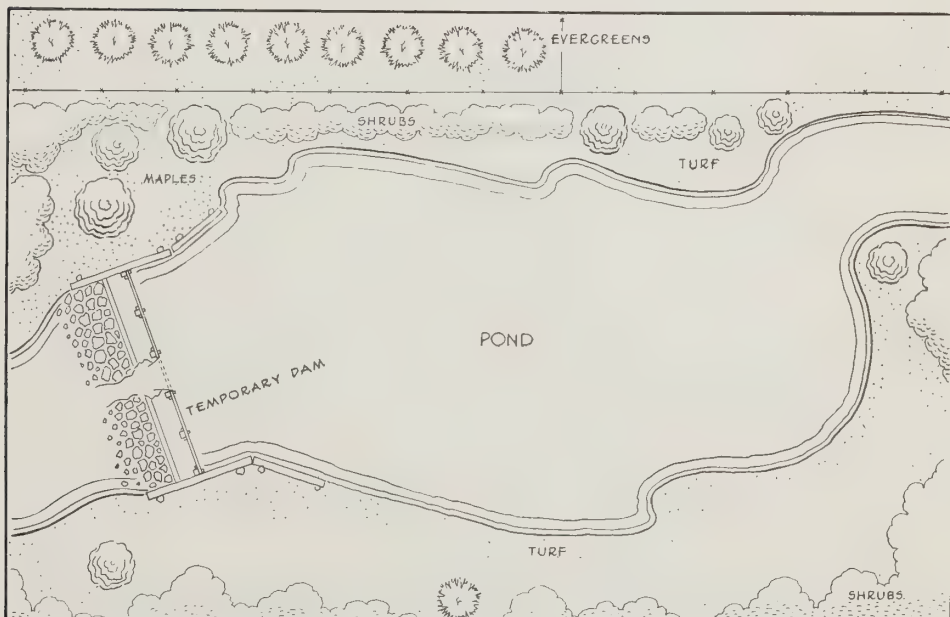
(2) The slopes of the dam

The tendency in building small dams is to make the slopes too steep, thus leaving the earthwork more subject to seepage and possible failure when the pond is full. A little extra work in soil moving will provide this necessary element of safety, and for all dams described in this report the slope recommended is 3 to 1 on the upstream side and 2 to 1 on the downstream side. Trees or shrubs should not be

THE TEMPORARY POND



The above photograph shows a removable timber dam laid on a concrete sill to provide a swimming-pool for a boys' camp.

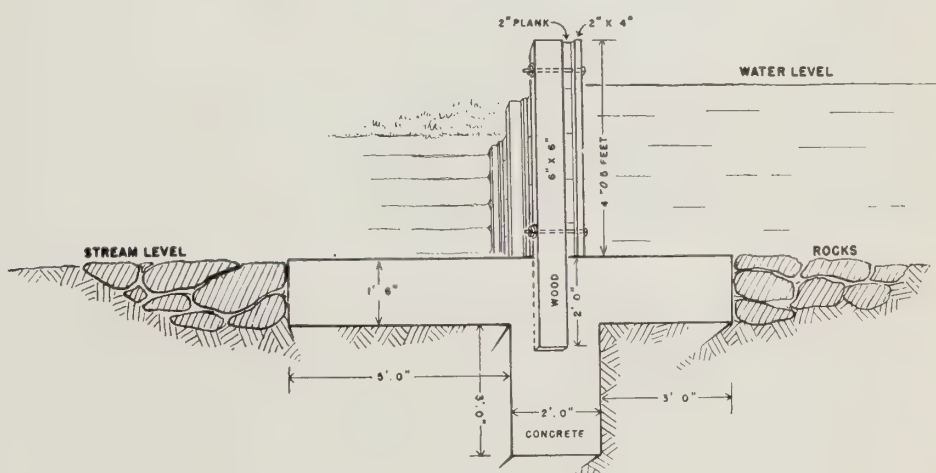


A plan indicating the position of the timber dam, the concrete footing, the apron of large flat stones at the base of the footing and other features.

THE TEMPORARY POND



A sketch of this type of pond with the timber structure simplified. In this case the 6 x 6 posts are set vertically in the concrete and each section between the posts, which are approximately 4 feet long, can be removed separately. The whole structure rests on a heavy concrete footing which is embedded in the stream bed. Such a dam will provide 5 or 6 feet of water for a pond which can be used for stock-watering, recreation and fire protection.



A section of the dam indicating the position and size of the concrete footing and protecting flat rock. When the dam is removed in the autumn it is suggested that old sacking be placed in the holes which take the uprights, so that these will not be filled with silt during the spring run-off.

planted on the dam proper because their roots provide channels for seepage, but a good turf should be established on the slopes as soon as possible. Burrowing animals of all kinds should be discouraged,

(3) The spillway

The spillway is the channel which carries off the surplus water when the pond is full. More dams fail because of inadequate spillway capacity than from any other cause. On big dams this is usually built into the concrete structure, or may be a separate channel some distance from the dam. For farm ponds it is usually a grassed waterway of gentle slope. This slope should not exceed 5 per cent. To keep the slopes of the grassed waterways as low as possible a small timber check dam may be used. The dug-out requires no spillway, the spring-fed pond should be provided with a grassed waterway, and none is required for the by-pass pond or the temporary dam.

With run-off ponds, and dams built on a permanent stream, an adequate spillway is necessary and requires careful calculations to make sure that it has sufficient capacity. Unfortunately the science of hydraulics in relation to run-off deals only with the movement of water on large watersheds, and although the science is considered accurate for basins of several square miles the formulae developed are not adapted to basins of a few acres. Consequently if the property owner is considering the building of a run-off pond or one on a permanent stream he must arrive at an approximation of the greatest flow which passes through the proposed site of the dam in times of greatest flood. This can be done by observation in the spring if it is a creek or narrow valley, or in the case of run-off ponds the amount of water from the area in question may be checked where it concentrates at a culvert and be measured there. Even after this amount has been estimated an additional amount for safety should be added.

(4) Discharge pipe or trickle tube

In any type of dam where the drainage pipe or trickle tube which is used for supplying water for stock or for emptying the pond passes under the earth dam, special precautions must be taken. This should be one of the first items considered in construction, because it must be on solid ground, otherwise the pressure of earth as it is built into the dam will cause it to buckle and leak. Moreover, it will be necessary to construct what is termed an anti-seepage ring at intervals of 36 feet along the pipe to prevent seepage from finding its way through the dam. These rings are sometimes metal, but the simplest type is a concrete square 2 feet by 2 feet by 6 inches, into which the pipe is embedded.

(5) Management

If ponds of any type are located on the farm property where cattle are at large, they should be protected by fencing to prevent them from entering and muddying the pond. If possible the fence should be set far enough back to permit grass and shrubbery to grow down to the water's edge and trees back of these. Such protection will keep the pond clean and suitable for other uses if such is the desire. Because of the increasing moisture of the area surrounding the pond, trees which thrive best in moist soil should be used, such as cedar, spruce, tamarack, willow, soft maple and elm. Shrubby should include those which provide food suitable for birds in winter. Care should also be taken not to allow weeds or excessive aquatic growth to take root in the pond, otherwise it will soon fill up with vegetation.

(c) Constructing the Earth Dam

The site of the dam should be cleared of all trash and topsoil down to the undisturbed soil. The site is then ploughed to give a rough surface to which fill will bond well. A trench at least one foot deep and one foot wide, although this will vary with the size of the dam, is

then cut along the middle of the dam site from one side to the other. This is the "core trench". The core of the dam should be made of the most clayey soil available, puddled and tamped into the core trench. The outlet pipe, if of drop inlet design, should rest on the undisturbed compact earth. If the pipe is concrete or cast iron a concrete collar is built in around it in the middle of the dam for stability and to check seepage along the pipe. This is the "anti-seepage" ring. It is considered that with corrugated pipe this is not necessary but even on this type a plate may be fixed for the same purpose.

The place from which fill for the dam is drawn is called the "borrow pit". Where possible the borrow pit should be the site of the pond, thus giving it greater capacity for water. If the soil on the pond site is not impervious enough then the borrow pit should be selected where soil is suitable but not too far away.

All topsoil should be removed from the borrow pit and set to one side. The heaviest, most clayey soil should be used for the core. Other soil may be used to build up the banks. The dam should be built up in approximately six-inch layers so that the movement of machinery back and forth packs it down evenly. Fill material should be free of stone, gravel, boulders and trash, that is, as nearly homogeneous as possible. Silty material is suitable if there is a good proportion of clay with it but not silt alone. The heavy clay should only be in the core where it will remain moist and stable.

The topsoil from the borrow pit is put on the dam last, especially on the crown and downstream side where it is necessary to support a good growth of sod. Where a permanent water level touches the dam rip rap may be built in to resist erosion by wave action. The dam should have slopes of 2 to 1 on the downstream side and 3 to 1 on the upstream side.

The crest of the dam should be at least six feet wide. If it is to be used as a roadway it must be twelve feet or more in width, but as this adds considerably to the fill needed such use should be avoided in most cases. The top of the dam should be three feet or more above the water level plus allowance for settling of fill.

Where an emergency spillway is provided to carry surplus water in maximum flows, it should be located so that its entrance has a minimum risk of being jammed by ice. The spillway should conform as nearly as possible to the natural lay of the land and should be "cut out" rather than "built up" so that its floor is compact and stable.

The hazard of erosion is acute on earth spillways with no more protection than that afforded by sod. It is necessary, then, to keep to as low a gradient as possible. To do this one or more terraces may be built in with an overdrop of timber, concrete or concrete block and an apron of concrete or boulders to break the fall of water. An alternative is to pave the floor of the spillway with concrete.

The most common arrangement for carrying overflow is the drop inlet type of discharge pipe. This consists of a discharge pipe placed horizontally, or nearly so, under the dam to which a "riser" is joined at the upstream end. The height of the rise determines the permanent level. This should be six inches or more below the level of the emergency spillway.

The inlet to the riser should be protected by a heavy screen, preferably in the form of a box, to keep trash and ice out of the pipe. If the riser is built into the dam there should be a baffle board against the dam to protect it from erosion by swirling waters entering the pipe. The outlet should splash onto concrete or stone so that the stream bed is not cut away.

The riser can be attached with a T-joint so that water may be allowed out of the dam by opening a gate or plug at the upstream end of the discharge pipe. This has a number of advantages. If the portion of the stream below the pond has trout then cool water from the bottom of the pond may be delivered downstream. Opening the pipe allows the pond to be drained for flushing out silt, to allow it to be cleaned or to empty it to provide storage for anticipated heavy flow.

If the pond is to be used for watering cattle a pipe may be led from the pond to a watering-trough and the water delivered by gravity. The inlet to the delivery pipe can be put below the permanent level and flow through it controlled by a float valve on the watering-trough.

(d) Detailed Descriptions of Farm Ponds

This section includes a detailed description of the six types of ponds already mentioned in this publication, namely, the dug-out, the spring-fed pond, the by-pass pond, the run-off pond, the permanent stream pond and the temporary pond. Each is described with four illustrations, namely a photograph of the type of pond described, either completed or in process of building; a perspective drawing showing the topography of the area in which the pond is located, and a suggested treatment of what such a pond might look like when complete; a plan indicating the different parts of the pond and a suggested treatment for landscaping; and a cross-section which should be of assistance in the actual constructing of the pond. Each set of four drawings is supported with full captions which indicate the parts of the illustrations which require emphasis.

7. Recreation

If the Neebing Authority decides to proceed on a program of land acquisition for the creation of an Authority Forest, it might keep in mind the fact that the urban

population of the area is growing. This growth is bound to place a strain on local recreational facilities by those who want to get away from the city for short periods but who are not able to travel long distances to do so. Multiple use of suitable Authority land could help to fill this gap and at the same time play a part in the educational program of the citizen who uses our resources.

WATER

CHAPTER 1

CHARACTERISTICS OF THE WATERSHED

1. Drainage Area

The drainage area of the Neebing River comprises about 85 square miles. The upper part of the watershed is roughly circular in shape extending from a point 2 miles north of the Dawson Road south for 11 miles to within a short distance of the Kaministikwia River with a maximum width at John Street of about 9 miles. The lower part of the watershed or the area below the "Forks", is six miles in length with a maximum width in the vicinity of the airport of $2\frac{1}{2}$ miles tapering to about $\frac{1}{4}$ mile at the mouth of the river in Thunder Bay, Lake Superior.

In the upper part the terrain is generally well-wooded, sloping steeply to the south-east. Below the "Forks" the area is quite flat being largely cleared and for the most part well settled.

About 2 square miles of the headwater zone is in the Township of Ware. The remainder of the drainage area is contained within the Townships of Oliver, McIntyre (Shuniah), Paipoonge, Neebing and the urban municipality of Fort William. A small segment of the city of Port Arthur also comes within the watershed. Other unincorporated communities contained within the area are: Intola, Baird, Murillo and Rosslyn. A plan of the watershed is shown in Figure 1.

2. River and Main Tributaries

The Neebing River rises in three main branches to the west and north-west of the city of Fort William. These tributaries are known respectively as the North Branch, the North West Branch and the South Branch.

The North Branch flows in an easterly direction and joins the Neebing River $1\frac{1}{2}$ miles south of the Dawson Road. The North West Branch flows in a general south-easterly

NEEBING RIVER WATERSHED

SCALE OF MILES



ONTARIO DEPARTMENT OF PLANNING & DEVELOPMENT
— CONSERVATION BRANCH —

LEGEND

- FLOOD DAMAGE AREA.....
- RESERVOIR AREA
- RIVER GAUGE



FIG. 1



direction to its confluence with the main river just below Oliver Road. From this point the river continues in a southerly direction for a distance of $3\frac{1}{2}$ miles where it is joined by the South Branch flowing from the west.

This confluence, commonly referred to as the "Forks" is located 2 miles upstream from the city of Fort William.

From the "Forks" the river flows eastward entering the city at Neebing Avenue about 1 mile south of the northerly city limit. From Neebing Avenue the river continues in an easterly direction for a distance of $3\frac{1}{4}$ miles where it crosses over into the city of Port Arthur and passes on to its outlet in Thunder Bay about $\frac{3}{4}$ of a mile farther east.

The lower part of the river averages about 55 feet in width during normal flow with a depth from 5 to 8 feet. The water level in the river is practically the same as Lake Superior for a distance of almost 2 miles from its mouth and shows little change as far as the westerly limit of Fort William a distance of 4 miles from the Bay.

The stream gradients of the main channel vary from 4 feet per mile in the lower part to as high as 98 feet per mile at the headwaters with an average gradient from the headwaters to the mouth of 38 feet per mile. Mean gradients for the North, North-West and South Branches are; 66.4, 45.1 and 25.5 feet per mile respectively.

The stream gradients for the river and its main tributaries are shown graphically and in table form in Figure 2.

1350

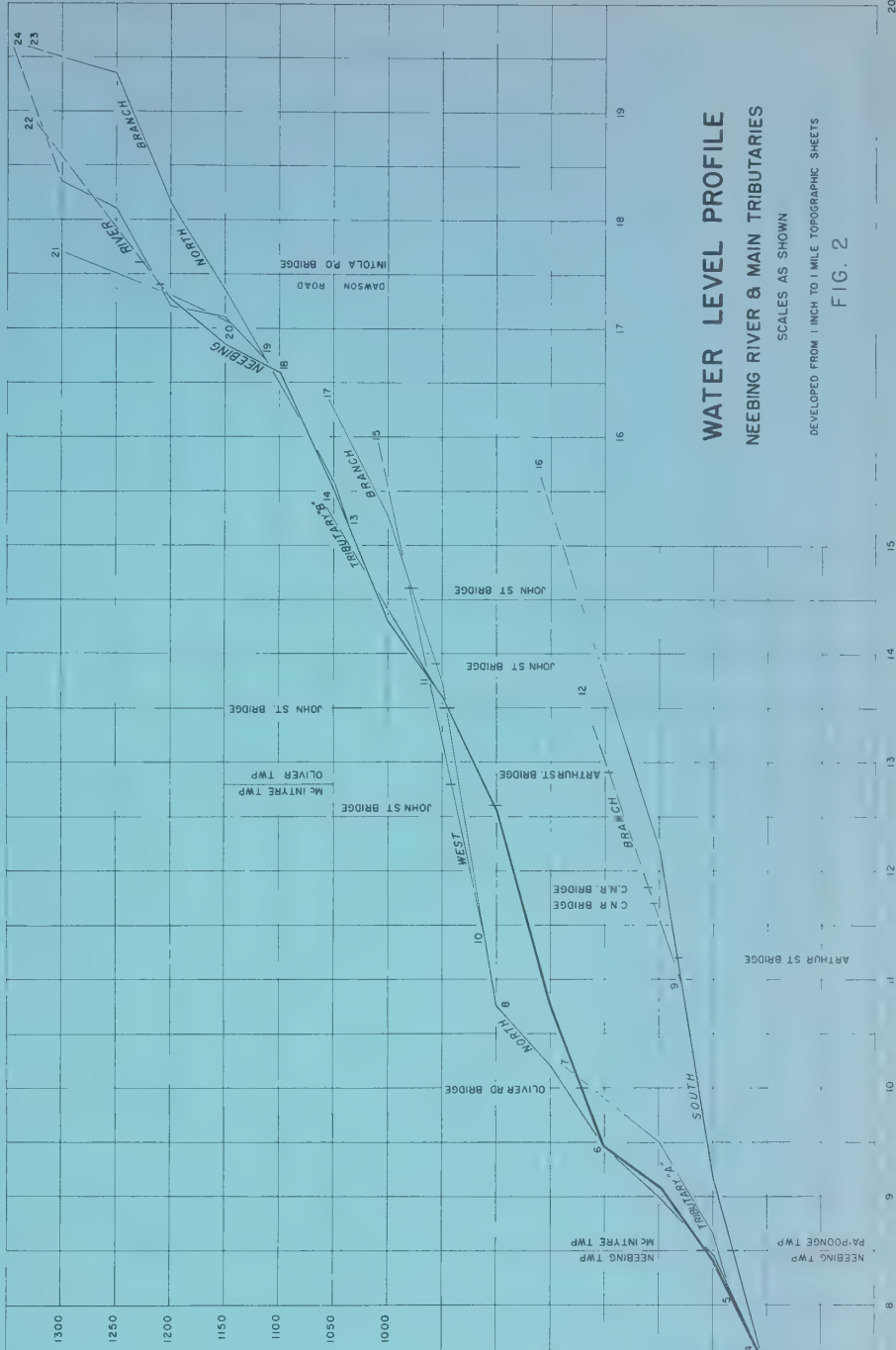
ELEVATION IN FEET

GRADIENT TABLE				
RIVER	FROM POINT TO PT., IN MILES	ELEVATION OF POINTS	DIFFERENCE ELEVATIONS	
NEEDING RIVER	1 3	603	632	28.7
"	3 6	2.30	800	168.3
"	6 18	7.15	800	73.2
"	18 22	2.30	1100	300.0
"	22 22	16.90	603	97.8
SOUTH BRANCH	2 16	9.40	622	722.0
"	9 12	2.60	730	862
"	12 8	3.15	660	900
N.W. BRANCH	4 8	17	5.60	900
"	8 17	8.75	660	1055
"	10 15	4.50	913	1010
TRIBUTARY "A"	5 7	2.20	682	835
TRIBUTARY "B"	11 14	1.55	958	1057
NORTH BRANCH	13 23	4.40	1038	1350
"	19 24	2.90	1113	1345
"	20 21	0.60	1148	1300

C.P.R. BRIDGE
SIMPSON ST. BRIDGE - BOUNDARY FORT WILLIAM / PORT ARTHUR
VICKERS ST. BRIDGE
CAMERON ST. BRIDGE
C.N.R. BRIDGE
NEEDING AVE. BRIDGE - WESTERN CITY LIMIT FORT WILLIAM

NEEDING RIVER

DISTANCE IN MILES



WATER LEVEL PROFILE
NEEDING RIVER & MAIN TRIBUTARIES

SCALES AS SHOWN

DEVELOPED FROM 1 INCH TO 1 MILE TOPOGRAPHIC SHEETS

FIG. 2

CHAPTER 2

HYDROLOGY

1. Recorded Stream Flows

A stream flow gauge was established at the Highway No. 17 (Bridge 35) crossing of the Neebing River in 1940 and a record of the flood stages was kept until 1943. The gauge was re-established in September, 1953, and daily flow records have been kept since that time.

The river has a drainage area of 75.8 square miles at this point, and a summary of the flows on record is shown on the accompanying table. The greatest recorded mean daily spring flow is 1,460 c.f.s.* which occurred in 1954. Low flows of 1 c.f.s. have been recorded on several occasions.

The 1941 recorded water levels show that the 3.88 inches of rainfall during the period September 18 to September 20 produced a maximum mean daily flow of 2,480 c.f.s. with a probable momentary peak flow of 3,820 c.f.s. at the gauge. The estimated peak flow through the trouble area for this flood is 4,330 c.f.s., which is equivalent to a run-off of 51.0 c.s.m.†

2. Future Flows

(a) Probable Maximum

The highest observed peak flow on the Neebing occurred on September 22, 1941 and was the result of an 84-hour rainfall of just less than 4 inches averaged over the watershed.

The records of the few Northern Ontario storms, for which data are available, analysed during the summer of 1955 revealed 5 occasions since 1923 when 4 inches of rainfall

* c.f.s. - cubic feet per second.

† c.s.m. - cubic feet per second per square mile.

MAXIMUM AND MINIMUM MEAN DAILY AND MEAN MONTHLY
FLOWS FOR THE NEEBING RIVER

Gauge at bridge 35 - Highway 17 - $5\frac{1}{2}$ miles west of
Fort William, Ontario.

Drainage area - 75.83 square miles

Year	Month	Discharge in C.F.S.		
		Max.	Min.	Mean
1953	September	23	-	5
	October	25	7	11
	November	23	6	11
	December	22	4	11
1954	January	6	3	4
	February	5	3	4
	March	14	5	7
	April	688	9	270
	May	1,460	59	314
	June	162	7	64
	July	6	1	3
	August	6	1	2
	September	8	2	4
	October	17	5	8
	November	20	6	11
	December	9	3	5
1955	January	4	2	3
	February	4	2	3
	March	6	3	4
	April	665	7	229
	May	184	14	57
	June	20	1	8
	July	7	1	3
	August	12	1	3
	September	30	1	11
	October	243	12	43
	November	232	48	90
	December	52	14	28
1956	January	24	12	17
	February	20	10	12
	March	39	12	19
	April	676	36	371
	May	408	66	204
	June	190	12	49
	July	162	10	34
	August	14	3	6
	September	21	4	9
1943	April	762	-	-
	May	563	-	-
	June	758	-	-
1942	April	615	-	-
	May	847	-	-
	June	310	-	-
1941	April	1,365	-	-
	September	2,480	-	-
	October	861	-	-
1940	April	309	-	-

Note: Records for 1940 to 1943 are for
flood flows only.

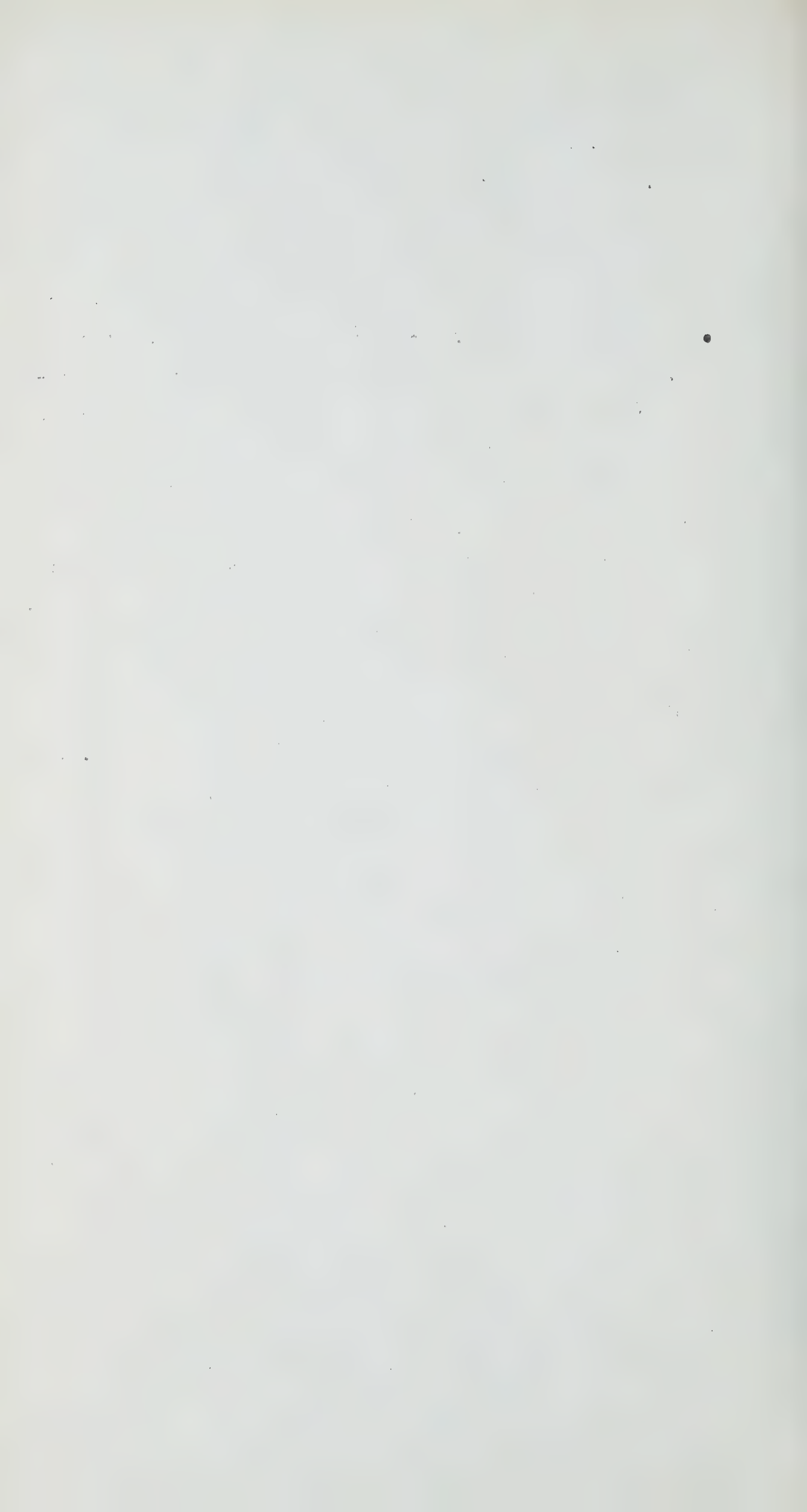
(over 75 square miles) was exceeded in a storm. In addition from the U.S. Corps of Engineers' Report "Storm Rainfall in the U.S." 5 severe storms which occurred in northern Minnesota and North Dakota and which could have centred over the Neebing Watershed, were noted. Of these 10 storms the most severe by a considerable margin was the Beaulieu, Minn. storm of July 18 to 23, 1909. Beaulieu is about 300 miles from Fort William and there is no doubt in the mind of our hydro-meteorologist that such a storm could occur over the Neebing area. If this storm had centred over the Neebing Watershed there would have been 10.3 inches during the heaviest 6-hour rainfall period and 12.0 inches for the 60-hour duration of the storm. The Beaulieu storm when transposed to the Neebing Watershed area and adjusted for maximum air moisture content, may be taken as the best estimate of probable maximum rainfall the presently available data permit. The study shows that the probable maximum flow at the gauge, in the event of such a storm occurring over the watershed, would be 10,500 c.f.s. which is equivalent to a run-off rate of 138.5 c.s.m.

When the construction of flood control works is contemplated, particularly in the case of large dams on the main streams, this figure would be a minimum value for design purposes. The rate of run-off increases as the drainage area decreases, and therefore somewhat higher values would be required for works constructed farther upstream.

(b) Hypothetical

The policy in the past has been to provide flood protection to the extent of a flood 1-1/3 times greater by volume than the greatest flood on record. Such a flood used for design purposes has been designated as the "Hypothetical" flood.

The greatest recorded flood flow on the Neebing River occurred on September 22, 1941, when a maximum mean daily flow of 2,480 c.f.s. was recorded. Increasing



this flood $1/3$ by volume gives a maximum mean daily hypothetical flow of 3,300 c.f.s. with a possible momentary peak flow of 5,100 c.f.s. This is equivalent to a run-off of 60.0 c.s.m.

These figures are considered adequate for the design of lesser flood control structures where overtopping would not cause any risk of life or serious property damage and for the determination of the volume of storage required when flood control by means of reservoir storage is contemplated.



Fort William, April 1950. Ice and flood waters rise almost to the walls of private dwellings.



May 1950. Balmoral Street flooded by overflow from the Neebing River.

CHAPTER 3
THE FLOOD AND LOW FLOW PROBLEM

1. Kind and Extent of Damages

There are two distinct problems which arise as a result of the variation in flow of the Neebing River. It is either a case of too much or too little natural stream flow at the wrong time.

Of the total 85 square miles of drainage area of the Neebing River only about 6 square miles lie within the boundaries of the city of Fort William and it is in this area that most of the flood damage is experienced and the pollution becomes a problem.

The damage consists of actual structural damage to buildings on the properties adjoining the river and to bridges crossing the channel. Much inconvenience is also caused through interruption of sewage facilities. Most of the sewer system is below the level of the river and is flooded during periods of high flow. At such times raw sewage is bypassed directly to the river or is backed up into basements, threatening the health and welfare of a large part of the city's population. Similarly, at times of low flow, wastes are stranded along the sides of the river and in backwater areas where they decay producing foul odours, creating a threat to health and spoiling the recreational value of the river.

Much of the damage is intangible and is difficult to estimate in dollars, but no doubt there is a distinct loss through inconvenience and the health hazard in addition to the visible structural damages.

From time to time the City Council has been faced with large claims for damages from citizens affected by the flooding. In the year 1950 alone, these claims amounted to \$75,000. Such floods occur almost annually during the

spring break-up and often during the summer months following severe rainstorms. Thus over a period of years the damages amount to a considerable sum.

2. Flood and Low Flow Conditions

(a) Flooding

The Neebing River with its low banks and shallow channel, has not sufficient channel capacity to contain the flood flows. The flooding not only affects the properties adjoining the river, but about one-third of the homes experience trouble with sewers backing up when the river is in flood. The area which is affected is indicated on the accompanying plan.(Figure 1).

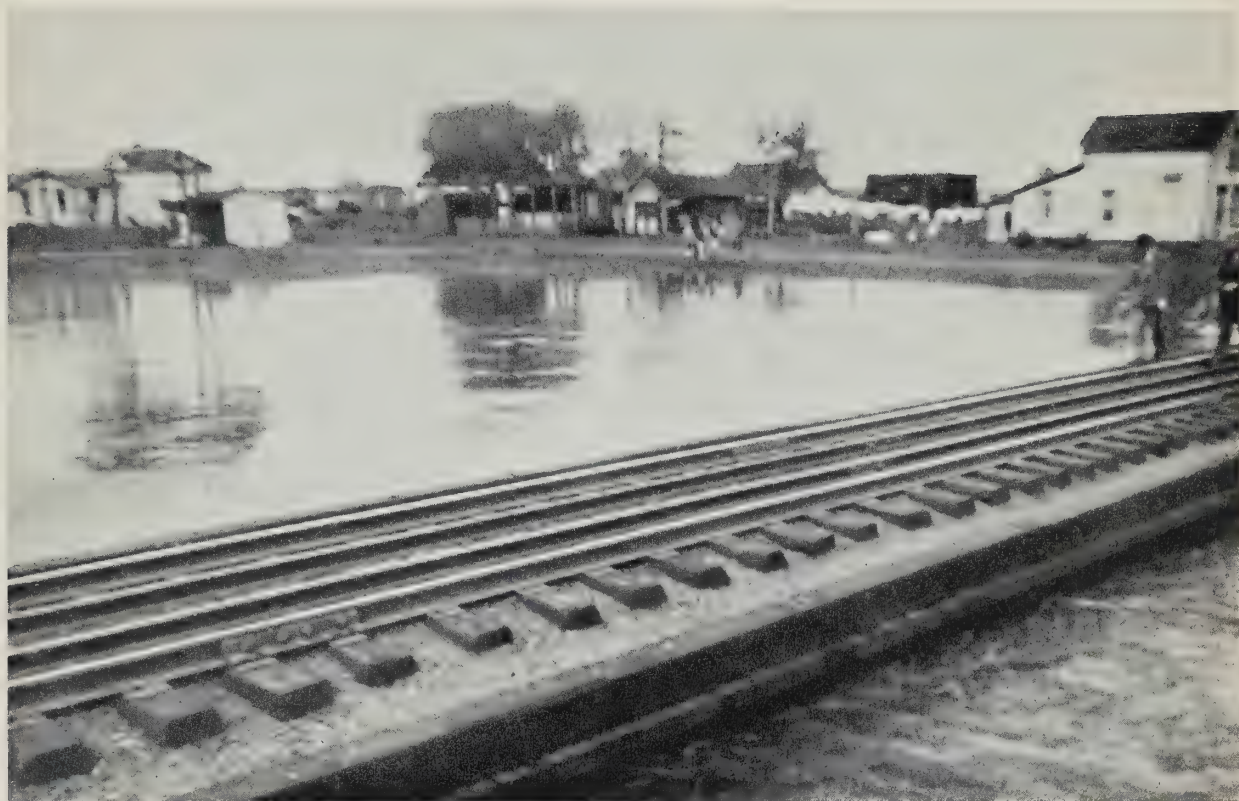
Within the city there are seven bridges over the river where flooding occurs. One is owned by the Canadian Pacific Railway, two by the Canadian National Railway and four by the City.

The Canadian National Railway bridge at Vickers Street and the Canadian Pacific Railway bridge are low timber structures on pile bents which seriously obstruct the free passage of flood flows and cause ice jams.

A difference of as much as 22 inches in the level of the water above and below the bridge has been noted at the Canadian Pacific Railway bridge. Differences between the upstream and downstream water levels have also been noted at the Canadian National Railway bridge at Vickers Street, which indicate that the structures are obstructing the flow.

The City has replaced the Vickers and Cameron Street bridges, which improves the normal flow conditions at these points but does not help the flood problem materially.

Owing to the low nature of the surrounding land, it would be difficult to construct bridges with adequate clearances. This is particularly true of the railway bridges since sudden changes in grade are not feasible.



May 1950. Flood waters from the Neebing River have risen to the underside of the C.N.R. bridge at Vickers Street.



May 1950. Another view of the C.P.R. bridge downstream from the Simpson Street bridge.

The Neebing River has a "drowned" mouth, and the water level in the last 2 miles of the river fluctuates with the levels of Lake Superior. The gradient of this stretch is extremely low in contrast to the high gradient of the river approaching the city and is probably the chief contributing factor to the flood problem. The flooding is further aggravated when high lake levels coincide with periods of high flows.

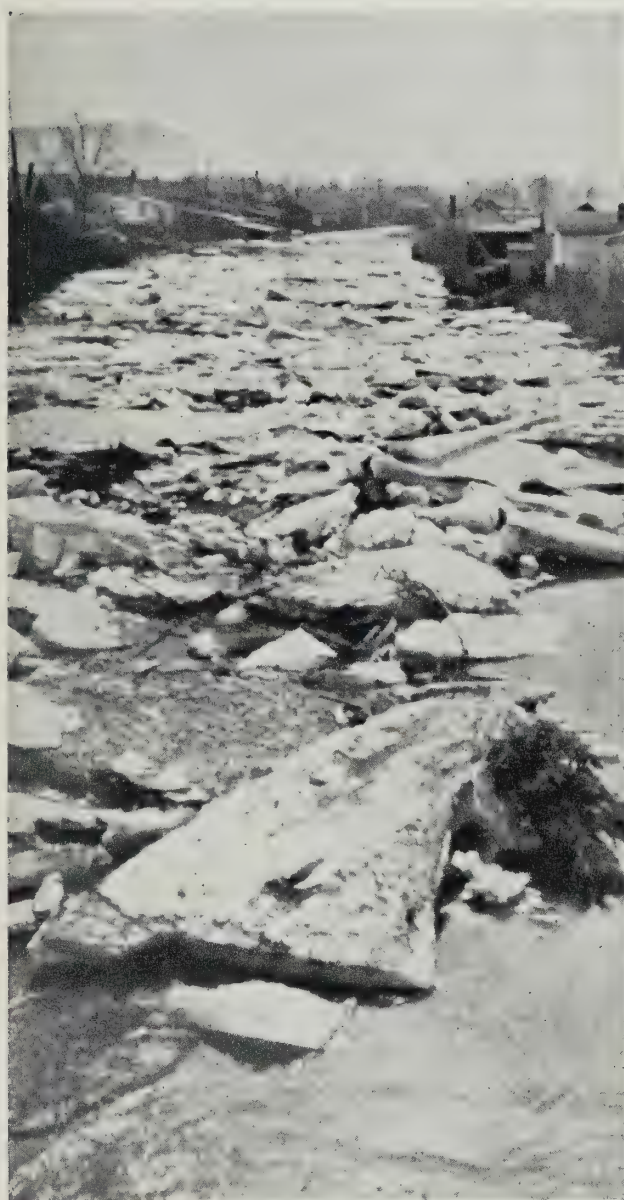
The increase in frequency and severity of the flooding, in part, may be attributed to the changing conditions on the drainage area. The area is being cleared steadily, with less than 60 per cent now remaining under forest cover, and opened up by roads and ditches. The Lakehead Airport has been improved and expanded, and its large paved surfaces induce a rapid rate of run-off, all of which tends to increase the flood flows and reduce the normal flows of the intervening periods.

(b) Low Flows

In addition to the flood problem, pollution both during periods of high flows, when the sewers are flooded, and at times of low flow, when there is not sufficient natural flow to dilute and remove the city wastes, is a major concern in this area.

The Neebing River receives pollution from several sources. Outside the city the river has a normal appearance and the only apparent pollution is from the natural drainage of farmlands. Within the city there is visible evidence of pollution, which increases and reaches a maximum at the outlet of the sewage treatment plant near the Canadian Pacific Railway bridge. The river from here to the mouth is heavily polluted and particularly obnoxious during the summer months, when the temperatures are high and there is insufficient flow to remove the wastes.

From the flow records it will be noted that the natural flow often falls to 1 c.f.s., which is entirely inadequate to flush out the lower river.



April 1950. With the proposed diversion, the water level will never exceed the capacity of the channel and ice flows, if kept moving, will not cause flooding.



April 1950. C.P.R. bridge over the Neebing River downstream from the Simpson Street bridge. There is only 3 feet clearance in normal water level and when in flood it raises the water level and greatly aggravates flooding.

FLOOD REFERENCES

- 1927 - May 13 "The Neebing and other streams are running stronger than for years. This will facilitate the driving of logs." Fort William Times-Journal, May 13, page 1, col. 5.
- 1932 - April 8-9 Sewers and basements flooded, parts of streets covered, at Fort William. Fort William Times-Journal, April 9, page 1, col. 1; April 11, page 3, col. 2.
- 1934 - May 3-4 Threat of flood, but no serious trouble, at Fort William. Fort William Times-Journal, May 4, page 1, col. 7.
- 1935 - April 13-15 At Fort William, "unprecedented in many years". farm lands flooded, sewers backed up, homes flooded. Fort William Times-Journal, April 13, page 3, col. 1; April 15, page 1, col. 3.
- 1941 - Sept. 22 At Fort William, streets and basements flooded. Fort William Times-Journal, Sept. 22, page 1, cols. 3-4-5, and cols. 6-7; and also memoranda from City Engineer's note-book.
- 1943 - June 15 At Fort William, the Neebing reported 12 to 18 inches above normal, not flooding, "behaving very decently". Fort William Times-Journal, June 15, page 1, col. 4; page 9, col. 6.
- 1944 - Aug. 10 At Fort William, the river reported running very high, threat of flood. Fort William Times-Journal, Aug. 10, page 3, col. 3.
- 1944 - Sept. 4-5 At Fort William, the river reported six feet above normal. Fort William Times-Journal, Sept. 5, page 1, cols. 1-2.
- 1947 - June 2-5 At Fort William, 2.24 inches of rain fell; damage to roads and culverts, and to one farm. Port Arthur News-Chronicle, June 5, photo; Fort William Times-Journal, June 5, page 1, col. 3; and col. 5.
- 1950 - April 17 At Fort William, streets, basements, and underpass flooded. Fort William Times-Journal, April 17, page 1, col. 7; April 18, page 1, cols. 6-7; April 19, page 1, col. 7.
- 1950 - May 5-6 At Fort William, streets and basements flooded. Fort William Times-Journal, May 6, page 1, cols. 1-2.
- 1951 - April 14-16 At Fort William, the river was "up several feet", threat of flood, but apparently no actual flooding. Fort William Times-Journal, April 14, page 1, col. 5; April 16, page 1, col. 5.
- 1954 - May 1 At Fort William, some parts of the city flooded. peak expected "this afternoon" (May 1). Port Arthur News-Chronicle, May 1, page 2; Fort William Times-Journal, May 1, page 1.



May 1950. Flood waters rise close to homes on River Avenue.



May 1950. Flood waters at Alexandra Street and William Street two blocks from the Neebing River channel.

CHAPTER 4
REMEDIAL MEASURES

1. Degree of Flood Protection

Protection against a maximum flood in Fort William would require a channel of sufficient size to accommodate a peak flow of 10,500 c.f.s. or reservoirs to provide about 28,620 acre feet* of storage on the Neebing River and its tributaries. This amount of potential storage does not exist on the watershed and if it did the cost of its development would be prohibitive. The reservoir site at the forks which was part of the abandoned diversion scheme is the best on the watershed and would be part of any flood control scheme. It has a capacity of 1,880 acre feet which is only about 7 per cent of the total storage required for full flood protection. Therefore it is obviously necessary to settle for something less.

The policy of this Department in Southern Ontario has been to provide protection against floods 1-1/3 times greater by volume than the greatest flood on record. This is called the Hypothetical or design flood. However, where dams are used for flood control they must be designed to discharge the probable maximum flood and, if the Hypothetical flood is exceeded, there would be flooding below but to a lesser degree.

The greatest recorded flood at Fort William occurred on September 22, 1941, as a result of an 84-hour rainfall of just less than 4 inches (averaged over the watershed). The records for the Neebing gauge date from 1941 only, and have a ten-year gap during the interval between 1943 and 1953. Based on the 1941 flood, however, and an estimated

* An acre foot of water is an area of 1 acre of water with a depth of 1 foot. The term is used instead of cubic feet or gallons to avoid astronomical numbers.

"Channel Capacity"* of 560 c.f.s., protection against the hypothetical flood would require at least 7,344 acre feet of storage. The surveyed site at the forks has a capacity of 1,880 acre feet. Therefore (7,344 - 1,880) or 5,464 acre feet of additional storage would be required upstream from the forks site.

Owing to the lack of hydrometric records it is not known just what degree of protection the storage in the forks site alone would provide, but a considered opinion is that, barring ice jams at the railway crossings it would be sufficient to control an average spring flood.

A probability curve for rainfall which has been prepared using meteorological records shows that a storm such as occurred in 1941 could be expected once in twelve years and for the hypothetical flood about once in fifty years. Although probability curves are theoretically correct, too much reliance should not be placed on their return period owing to the abnormal climatic conditions experienced in the last two decades. For instance a frequency curve for the Grand Watershed prepared from flow records dating from 1914 to 1939 showed that the great flood of 1938 was a "once in a hundred years" flood. Yet it has been exceeded 4 times since, viz; in the spring of 1942 and was greatly exceeded in the spring floods of 1947 and 1948 and the flood following Hurricane Hazel in 1954.

2. Neebing Dam and Reservoir and Diversion Scheme

Over the years many proposals to overcome the problems of floods and pollution have been put forth. Storage

* The channel capacity is the rate of flow or stage in the river at the trouble area which just reaches the top of the bank or, in Fort William's case causes water to back up into the sewers. The channel capacity value is necessary to determine the storage required for flood control and is found by a test (yet to be made) which involves timed readings taken during a flood period by the gauge reader and another observer at the critical point noting the exact times when the flood waters rose to and later receded to the required stage at the critical point.

reservoirs outside the city limits would be the ideal solution, and a rough survey of the watershed was made in 1942 by the city engineer, to determine if suitable sites were available. This survey was disappointing as no large reservoir site was found.

Diversions to the Kaministikwia and the MacIntyre Rivers were also considered, but the size of channels required to carry off the surplus flood waters made these schemes impractical. Also, this method did not provide any relief for the pollution problem.

A combination of the two methods was proposed, and to this end the firm of R. K. Kilborn & Associates Ltd., consulting engineers, was engaged to investigate and report on the scheme. The necessary field surveys were carried out during the summer of 1955, and their report was submitted in September of that year.

This report recommended the construction of a dam on the main Neebing River just below the confluence of the South Branch in conjunction with a diversion channel from the reservoir to the Kaministikwia River as indicated on the accompanying plan. Structures at this point would control the run-off from 73.5 square miles, or over 86 per cent of the total watershed area.

The dam would be of the rolled earth fill type with a concrete sluiceway fitted with two 9- x 12-foot gates to regulate the high flows and a valve-controlled discharge tube for regulating the low flow discharges. The sluiceway would be of the low level type with gates designed to handle flood discharges up to approximately 5,000 c.f.s. The dam would be 270 feet long at the crest with a maximum height above the river of 43 feet. The reservoir would have a storage capacity of 1,880 acre feet and would extend back from the dam a distance of 2 miles along each of two arms.

The proposed channel, which would be concrete-lined throughout, was to follow a route generally south-east to the easterly limit of the Canadian National Railway yards thence approximately due south to the Kaministiquia River, a total distance of about 2.5 miles. The channel was to have a bottom width of 10 feet with side slopes of $1\frac{1}{2}$ to 1 and a depth of 15.8 feet. Designed to carry a maximum depth of water of 12.8 feet, the channel would safely discharge 3,000 c.f.s. However, due to circumstances beyond the control of the Authority, the location of this scheme has now been abandoned. There may be other methods for controlling the floods in Fort William and one or more are now under consideration. Before any further definite scheme can be proposed additional investigations will have to be carried out in the watershed and it is planned to do this in the very near future.

ABBREVIATIONS, EQUIVALENTS AND DEFINITIONS

Abbreviations

ac. ft.	is the abbreviation for <u>acre foot</u> which is equivalent to 43,560 cubic feet and is the quantity of water required to cover one acre to a depth of one foot.
c.s.m.	is the abbreviation for <u>cubic feet per second per square mile</u> and is the average number of cubic feet of water flowing per second from each square mile of drainage area.
c.f.s.	is the abbreviation for <u>cubic feet per second</u> and is the unit generally used to express discharge or the rate of flow.
M.P.N. or m.p.n.	most probable number
ML or ml.	millilitre
P.P.B. or p.p.b.	parts per billion
P.P.M. or p.p.m.	parts per million
PH or ph	value measure of acidity or alkalinity

Equivalents

1 c.f.s.	= 6.25 imperial gallons per second
1 c.f.s. for 1 day	= 1.98347 acre feet or approximately 2 acre feet
1 c.f.s. for 1 year	= 724 acre feet
1 ac. ft.	= 271,472 imperial gallons
1,000,000 imperial gallons per day	= 1.86 c.f.s.

Definitions

BOOST STORAGE is the storage required to increase the head of water over the discharge tubes in order that they may be able to discharge the required flow.

CHANNEL CAPACITY or "IN-BANK" FLOW is the maximum flow which is contained within the river banks and does not overflow the adjacent low lands.

CHANNEL CAPACITY STORAGE is the volume of water that must be impounded in order that the stream flow will not exceed the channel capacity flow or stage.

(ii)

CONSERVATION STORAGE is that volume of water remaining in a reservoir which may be used to augment the low flows and is equivalent to the maximum storage capacity of the reservoir less the dead storage, evaporation and ice losses and the space reserved for flash floods.

DAM is a structure in and across a river valley to impound, control and otherwise regulate the river flow.

DEAD STORAGE is the amount of water kept in a reservoir at all times for the purpose of protecting the artificial and natural water seals at the base of the dam.

DISCHARGE TUBE or CONDUIT is an opening through the base of the spillway to provide means for discharging water when the water level of the reservoir is below the spillway level.

FLOOD is an overflow or inundation coming from a river or other body of water.

FLOOD CONTROL is the prevention of flooding by controlling the high water stages by means of storage reservoirs, dikes, diversions or channel improvement such as widening, deepening and straightening.

FLOOD CONTROL STORAGE is the total volume of water that must be impounded during a given flood in order that the stream flow will not exceed the channel capacity flow or stage and is equal to the sum of the channel capacity, dead, boost and operational storages.

FLOOD CREST is the maximum height or stage that the flood waters reach during any one flood period.

FLOOD HYDROGRAPH - a hydrograph which covers only the flood period or time interval during which the river flow is above the flood stage.

FLOOD RATIO is the rate of peak flow to the average flow for the flood period.

FLOOD STAGE is an arbitrary flow stage which varies from place to place and from season to season and is that flow or water level at which the water threatens to do damage.

FREEBOARD is the vertical distance between the maximum permissible water level and the top of the dam or dikes.

HYDRAULICS as applied to conservation deals with the measurement and control of run-off from river drainage basins.

HYDROGRAPH is a plot of flow against time and is a correct expression of the detailed run-off of a stream resulting from all the varying physical conditions which have occurred on the drainage area above the gauging station previous to the time which it represents.

HYDROLOGY is the science which deals with the occurrence and distribution of water in its various forms over and within the earth's surface. As applied to conservation it deals more specifically with that portion of the hydrologic cycle from precipitation to re-evaporation or return of the water to the seas and embodies the meteorological phenomena which influence the behaviour of the waters during this phase of the cycle.

OPERATIONAL STORAGE is additional storage that is required to provide a safety factor to enable the controller to regulate the discharge from a dam so as not to exceed the channel capacity flow or stage.

RATE OF RUN-OFF is the rate at which water drains from an area. Usually expressed in cubic feet per second (c.f.s.).

RATE OF RUN-OFF PER SQUARE MILE is the average number of cubic feet per second of water flowing from each square mile of area drained (c.f.s./sq. mi. or c.s.m.).

RESERVOIR is the body of water created by the construction of a dam.

RESERVOIR CAPACITY is the maximum amount of water that may be contained within the reservoir without exceeding the maximum permissible water level. Usually expressed in acre feet.

RUN-OFF is the amount of water which reaches the open stream channels and may be broadly defined as the excess of precipitation over evaporation, transpiration and deep-seepage.

RUN-OFF DEPTH IN INCHES is the depth to which the area would be covered if all the water flowing from it were conserved and uniformly distributed over the surface.

SPILLWAY is that part of a dam over or through which the water is discharged.

SPILLWAY CAPACITY is the maximum amount of water that may be discharged over the spillway without exceeding the maximum permissible water level in the reservoir.

STREAM GAUGE is a measuring device used to determine the elevation of the water surface at selected points - usually a graduated rod fixed in an upright position and set to a known elevation from which the gauge readings are obtained by direct observation. Automatic type gauge is a mechanically operated recording instrument which gives a continuous record of water surface elevations.

WATER or CLIMATIC YEAR is a 12-month period from October 1 to September 30. The water year was found to be a more convenient form than the calendar year for the purpose of stream flow studies as it groups together those months in which the water losses due to evaporation and vegetation demands are at a minimum (October - March) and those during which the losses are high (April - September).

Gov.Doc
Ont
P

6611473

Ontario. Planning and Development, Department of
Neebing Valley conservation report, 1957.

**University of Toronto
Library**

**DO NOT
REMOVE
THE
CARD
FROM
THIS
POCKET**

Acme Library Card Pocket
LOWE-MARTIN CO. LIMITED

